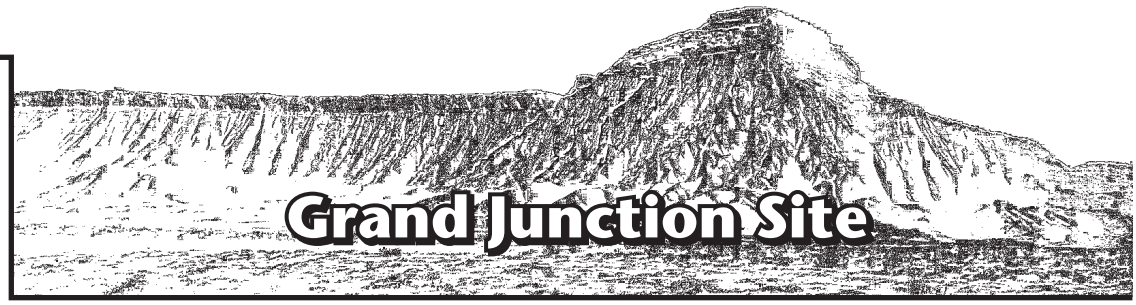
GJO–2004–560–TAC

Moab Project

Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System Moab, Utah, Site

February 2004



U.S. Department of Energy

Work Performed Under DOE Contract No. DE–AC01–02GJ79491 for the U.S. Department of Energy Grand Junction Site.
Approved for public release; distribution is unlimited.

GJO−2004−560−TAC
MOA 041.05

Moab Project

Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System Moab, Utah, Site

February 2004

Work Performed by S.M. Stoller Corporation under DOE Contract No. DE-AC01-02GJ79491
for the U.S. Department of Energy, Grand Junction, Colorado

X0063000

Signature Page

Moab Project

Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System Moab, Utah, Site

February 2004

Approved by:

Kenneth Karp
Moab Ground Water Manager
S.M. Stoller

2-3-04
Date

Melvin Madril
Project Engineer
S.M. Stoller

2/3/04
Date

Irwin Stewart
Moab Site Manager
S.M. Stoller

2/3/04
Date

Toby Wright
Moab Project Manager
S.M. Stoller

2/3/04
Date

Contents

Page

Figures

Tables

Appendices

Attachments are not available in electronic format
Contact Wendee Ryan to request

1.0 Introduction and Background

The Moab site is located in the northern portion of Spanish Valley about 3 miles northwest of the city of Moab in Grand County, Utah. The northwest portion of the valley is also referred to as Moab Valley. The site is irregularly shaped and encompasses approximately 400 acres; a 130-acre uranium mill tailings pile occupies much of the western portion of the site. The Moab site is bordered on the north and southwest by steep sandstone cliffs. The Colorado River forms the southeastern boundary of the site. U.S. Highway 191 (US-191) parallels the northern site boundary, and State Road 279 (SR-279) parallels the southwestern boundary, as shown in Figure 1-1.

The site is a former uranium-ore processing facility that has contaminated the alluvial ground water mostly beneath and downgradient of the tailings pile (DOE 2003a). Ground water contaminated with ammonia and other constituents flows to the southeast and is discharging to the west bank of the Colorado River in backwater areas that may provide suitable habitat for threatened and endangered aquatic species. Resulting contaminant concentrations in these areas are above protective criteria for aquatic species. Analytical data indicate that contaminants decrease significantly as ground water discharges to and mixes with surface water (a 10-fold decrease is observed on average for ammonia). A target goal of 3 mg/L ammonia in ground water next to the Colorado River provides reasonable assurance that protective surface water concentrations could be achieved.

DOE constructed an interim pump and treat system in 2003 to extract contaminated ground water before it discharges into the backwater areas. The pump and treat system consists of a series of ground water extraction wells and an evaporation pond. Ground water is extracted at the well field located along the west bank of the Colorado River and piped to an evaporation pond constructed on top of the tailings pile for treatment. The objective of the interim action is to:

- protect aquatic species by reducing ammonia contaminated ground water from discharging to potentially suitable backwater areas, and
- provide performance data for use in selecting and designing a final ground water remedy.

1.1 Purpose and Objective

The purpose of this document is to specify the operating and performance monitoring procedures for the interim action pump and treat system. This plan includes the following corresponding objectives:

Operating Procedures:

The objectives of these procedures are to provide for (1) safe conduct of operations, (2) inspections, and (3) maintenance activities for the pump and treatment system.

Performance Monitoring Procedures:

The objectives of these procedures are to provide necessary data to (1) optimize the pump and treatment system, (2) evaluate the effectiveness in reducing ammonia concentrations discharging to the surface water, (3) minimize the up coning of the salt-water interface in response to pumping the aquifer, and (4) develop and design a final ground water remedy.

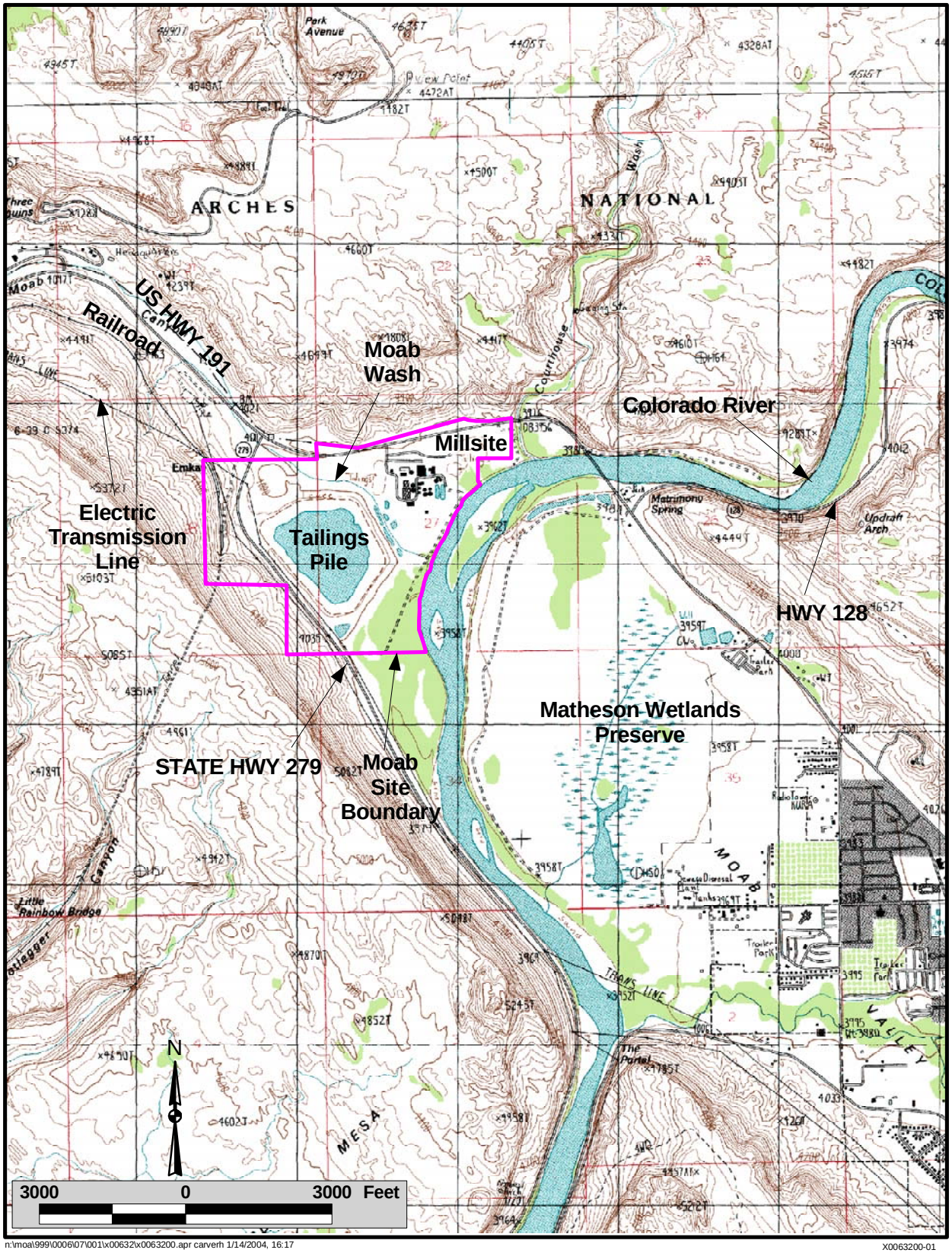


Figure 1-1. Location of the Moab Site

2.0 Operation Structure and Responsibilities

The Contractor is responsible to DOE for the operation and maintenance of the pump and treat system at Moab. To accomplish this, the Contractor has assigned personnel at the Moab site to carry out the day-to-day operational activities. The names, organizational relationship, contact numbers, and reporting relationships for Contractor personnel critical to the operations and maintenance activities of the interim action are identified in Table 2-1 and described below.

Table 2-1. Selected Stoller Personnel Critical to Operations and Maintenance Activities of the Interim Action Treatment System

Position	Name	Location	Phone Number
Moab Project Manager	Toby Wright	Grand Junction	(970) 248-6432
Moab Ground Water Manager	Kenneth Karp	Grand Junction	(970) 248-6564
Moab Site Manager	Irwin Stewart	Moab	(435) 259-5131/(970) 248-6338 (cell)
Project Engineer	Melvin Madril	Grand Junction	(970) 248-6487
Moab Operator	Randy Stevens	Moab	(435) 259-5131
Moab Project Safety Coordinator	Tom Guthrie	Moab	(435) 259-4892/(970) 640-3101 (cell)
Health and Safety Manager	Michael Hurshman	Grand Junction	(970) 248-6468
Environmental Compliance Lead	Paul Wetherstein	Grand Junction	(970) 248-6645
Quality Assurance Manager	Donna Riddle	Grand Junction	(970) 248-6433

2.1 Moab Project Manager

The Moab Project Manager is responsible for overall Moab program coordination and interaction with DOE. The Project Manager has overall Stoller responsibility to implement the selected remedial actions.

2.2 Moab Ground Water Manager

The Moab Ground Water Manager reports directly to the Moab Project Manager. The Ground Water Manager is responsible for the management, operation, and overall direction of the ground water interim action. The Ground Water Manager develops and manages cost and schedules for the interim action, is the first contact and line of authority for all communications regarding operation of the interim action, and has approval authority for maintenance and field changes with technical direction provided by the Site Manager and the Project Engineer. The Site Manager and the Project Engineer report directly to the Ground Water Manager on all aspects of the remediation system.

2.3 Moab Site Manager

The Moab Site Manager is located on-site and is responsible for the day-to-day operation, inspection, maintenance, and record keeping for the interim action. The Site Manager will direct the Moab Operator to carry out specific tasks as specified in the following procedures. The Moab Operator reports directly to the Site Manager. The Site Manager is the focal point for coordination of all site activities and works closely with the Moab Project Safety Coordinator to ensure implementation of health and safety requirements. The Site Manager is also responsible for emergency response as described in Section 11.0 of the Moab Health and Safety Plan (HSP) (DOE 2003b).

2.4 Project Engineer

The Project Engineer is the Contractor representative responsible for all engineering aspects of the pump and treat system and provides technical direction to the Ground Water Manager. The Project Engineer is responsible for the civil design, developing specifications and construction drawings, and modifications or expansions to the interim action system based on project objectives defined by the Moab Ground Water Manager.

2.5 Operator

The Operator is located on-site and is responsible for conducting periodic and routine inspections of the remediation system along with maintenance and minor repairs of the system, when necessary. The Operator is responsible for documenting operating conditions of the system such as flow rates, pressures, and water quality field measurements. The Operator also may be required to conduct additional work to monitor, document, and report on repair and maintenance work performed by subcontractors that will occasionally be necessary to keep the remediation system operating correctly. In the case of a power failure or severe storm event (electrical storm, wind and dust storm, storm causing flooding, etc.), an immediate inspection conducted by the Operator will be necessary.

2.6 Moab Project Safety Coordinator

The Moab Project Safety Coordinator reports directly to the Stoller Health and Safety Manager. The Project Safety Coordinator is the primary health and safety point-of-contact for on-site interim action activities, is responsible for implementing the Moab Health and Safety Plan, verifies compliance with health and safety requirements, and serves as the Radiological Control Technician (RCT). The Project Safety Coordinator also performs routine health and safety oversight of subcontractors that may occasionally work on the interim action system.

2.7 Health and Safety Manager

The Health and Safety Manager is the Contractor representative responsible for all site health and safety issues and will provide health and safety related technical direction to the Ground Water Manager, Site Manager, Project Engineer, and Operator.

2.8 Environmental Compliance Lead

The Environmental Compliance Lead is the Contractor representative responsible for all environmental compliance issues and will provide environmental compliance related technical direction to the Ground Water Manager, Site Manager, Project Engineer, and Operator, and will notify DOE in the event of a spill.

2.9 Quality Assurance Manager

The Quality Assurance Manager is the Contractor representative responsible for all quality assurance issues and will provide quality assurance related technical direction to the Ground Water Manager, Site Manager, Project Engineer, and Operator.

3.0 Pump and Treat System

The focus of the interim action is to reduce discharge of contaminated ground water to potentially sensitive surface water areas through mass removal of ammonia from the aquifer and by manipulation of ground water flow gradients. This is accomplished by extracting ground water from a well field located between the toe of the tailings pile and the Colorado River in an area where the highest ammonia concentrations have been observed in the shallow basin-fill aquifer. Extracted ground water is transmitted in an above ground pipeline from the well field to a lined evaporation pond located on top of the tailings pile. The evaporation pond is designed to treat contaminated ground water by evaporation at an average annual rate of 15 gpm. The main ground water transmission line from the well field area to the pond is designed to accommodate up to a total of 200 gpm if the system is expanded at a later date.

Details of the pump and treat system, including design drawings and specifications, are documented in the *Moab Project Site Ground Water Interim Action Remediation Construction Specifications* (DOE 2003c). The construction drawings are included in Attachment 1. The location of the well field, piping, and the evaporation pond is shown in Figure 3-1.

3.1 Well Field Design

The well field consists of a total of ten pumping wells and six observation wells located within an area approximately 75-feet wide by 250-ft long (Figure 3-1). The pumping wells are evenly spaced approximately every 25-ft along a line parallel to and within 60 to 65 feet of the Colorado River. The observation wells are nested in the center of the well field approximately 15 to 20 feet on either side of the centerline.

Each individual well is equipped with a submersible pump with an operating range rated between 1 to 7 gpm. The pumps are equipped with thermal overload protection and are designed to cycle every 15-minutes if the ground water level in the well decreases below the pump intake.

Contaminated ground water withdrawn from the pumping wells is piped to a collection manifold and then discharged to an evaporation pond located on top of the tailings pile. Flow rate, pressure, and cumulative volume are monitored at each extraction well and at the collection manifold. Valves and sampling ports are available at each extraction well for sample collection.

3.1.1 Well Installation and Construction

Extraction wells (MOA-470 through –479) shown in Figure 3-1 were installed between June 21 and 25, 2003, in borings advanced using an air-hammer percussion method. The six observation wells (MOA-480 through –485) also shown in Figure 3-1 were installed between June 20 and 23, 2003, using the same drilling method. Well construction information including well diameter, screen interval, and total depth is provided in Table 3-1.

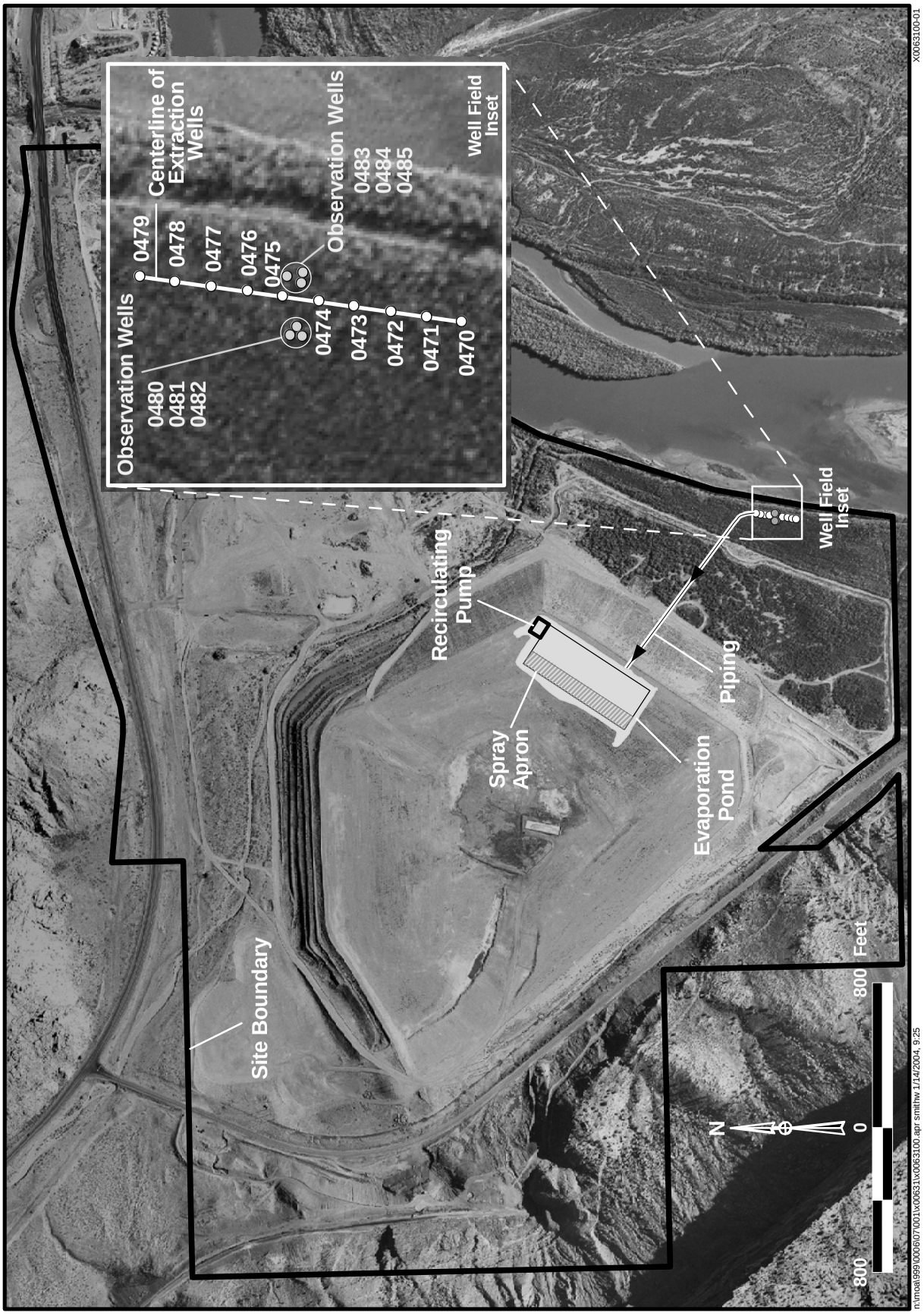


Figure 3-1. Location of Interim Action Well Field, Piping, and Evaporation Pond

Table 3-1. Summary of Well Construction Information

Well	Well Type	Diameter (inches)	Screen Interval (ft bgs)	Total Depth (ft bgs)
MOA-470	Extraction	4	10.3 – 19.7	21.3
MOA-471	Extraction	4	10.3 – 19.7	21.3
MOA-472	Extraction	4	10.3 – 19.7	21.3
MOA-473	Extraction	4	10.3 – 19.7	21.3
MOA-474	Extraction	4	10.3 – 19.7	21.3
MOA-475	Extraction	4	10.3 – 19.7	21.3
MOA-476	Extraction	4	10.3 – 19.7	21.3
MOA-477	Extraction	4	10.3 – 19.7	21.3
MOA-478	Extraction	4	9.6 – 23.9	25.5
MOA-479	Extraction	4	9.3 – 23.6	25.2
MOA-480	Observation / Shallow	4	15.5 – 19.8	20.3
MOA-481	Observation / Middle	4	25.4 – 29.7	31.3
MOA-482	Observation / Deep	4	55.4 – 59.7	61.3
MOA-483	Observation / Shallow	4	15.5 – 19.8	20.3
MOA-484	Observation / Middle	4	25.5 – 29.8	30.3
MOA-485	Observation / Deep	4	55.6 – 59.9	60.4

In general, the subsurface in the vicinity of the well field consists of sandy silt and silty sand deposits in the uppermost 10 ft below ground surface (bgs), which is underlain by 6 ft of fine to coarse-grained sand. At a depth of approximately 16 ft bgs a gravelly sand unit is present with thin interbedded clayey gravelly sand units. From 29 ft bgs, the lithology consists primarily of gravelly sand. The deepest depth drilled during this investigation was 65 ft. Lithologic logs and well completion information for each well are presented in Appendix A (Well Boring and Construction Logs).

3.1.2 Well Development

Wells were developed using standard surge and bail techniques. Development continued until the turbidity of the discharge water dropped below 10 NTUs. On average, over 2 hours was spent developing each well. The turbidity of the discharge water from some wells dropped quickly below the 10 NTU limit, which meant that limited time was required to develop those wells. Development records for each well are contained in Appendix B (Well Development Records).

3.1.3 Hydraulic Tests

Step-tests were conducted at each of the pumping wells after they were developed to collect hydraulic properties of the aquifer prior to operating the well field. The pump intake was at 18 feet below ground surface for all the tests. Plots of the results obtained from the step-tests are presented in Appendix C (Step-Test Plots). Pumping rates, drawdown, and calculated specific capacity for each step test performed is presented in Table 3-2.

The specific capacities during the 3 gpm step (1st step) range from 3.75 gpm/ft (wells MOA-476, -478, -479) to 5.0 gpm/ft (wells MOA-470, -473, and -474). Comparable specific capacities for the 10 gpm step (2nd step) range from 2.94 gpm/ft (well MOA-478) to 6.25 gpm/ft (well MOA-470). Specific capacities during the final step (3rd step which had a pumping rate from 11 to 20 gpm) range from 1.95 gpm/ft (well MOA-478) to 5.56 gpm/ft (well MOA-474).

Table 3-2. Pumping Rates, Drawdowns, and Calculated Specific Capacities for the Shallow Aquifer

Well	1st Step			2nd Step			3rd Step		
	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)	Q (gpm)	s (ft)	Specific Capacity (gpm/ft)
MOA-470	3	0.6	5.00	10	1.6	6.25	20	4.8	4.17
MOA-471	3	0.7	4.29	10	2.1	4.76	15.5	4.7	3.30
MOA-472	3	0.7	4.29	10	2.1	4.76	15.5	4.1	3.78
MOA-473	3	0.6	5.00	10	2.3	4.35	14	5.8	2.41
MOA-474	3	0.6	5.00	10	1.5	6.67	15	2.7	5.56
MOA-475	3	0.7	4.29	10	2.6	3.85	12.5	4.8	2.60
MOA-476	3	0.8	3.75	10	3.3	3.03	11	4.8	2.29
MOA-477	3	0.7	4.29	10	2.5	4.00	12	4.5	2.67
MOA-478	3	0.8	3.75	10	3.4	2.94	12.5	6.4	1.95
MOA-479	3	0.8	3.75	10	2.9	3.45	12	5.8	2.07

Q = Flow Rate; s = Drawdown; Spec. Cap. = Specific Capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

On the basis of these results, the most productive extraction well is well MOA-474, followed closely by well MOA-470. The least productive well among the group is well MOA-478. In general, the wells located in the southern portion of the well field appear to be slightly more productive compared to the wells located in the northern portion.

3.1.4 Baseline Conditions

Baseline data that can be used to evaluate the interim action's effectiveness in reducing ammonia concentrations in the backwater areas was collected prior to operating the system. Two rounds of sampling and analysis were conducted.

The first round consisted of collecting ground water samples from the ten extraction wells and from the six observation wells. A total of three to six samples were collected from each well at approximately every 2-feet in depth across the saturated portion of the screen interval using a peristaltic pump. Field measurements were performed for temperature, specific conductance, and pH with a YSI 6920 instrument to profile vertical changes in water quality. Measurements were recorded after the intake line was purged to ensure the sample was representative and after the field parameters stabilized. Field parameters for the vertical profile sampling from the extraction and observation wells are presented in Table 3-3 and Table 3-4, respectively.

Ground water samples collected using a peristaltic pump from the observations wells at the approximate mid-point of the saturated portion of the screen interval were filtered and submitted to the Environmental Science Laboratory (ESL) at Grand Junction for determination of density, total dissolved solids, total ammonia as nitrogen, chloride, nitrate, sulfate, and uranium. These laboratory results are presented in Table 3-5. All the data from this first sampling round was collected July 1, 2003 after the wells were fully developed, but prior to performing the aquifer step-tests.

Table 3-3. Baseline Vertical Profile Field Parameter Measurement Results for the Extraction Wells

Well	Sample Date	Static WL Below TOC (ft)	Screen Interval (ft bgs)	Sample Depth (ft bgs)	Temperature (°C)	Specific Conductance (µS/cm)	pH
MOA-470	7/1/03	12.78	10.3 – 19.7	13.5	15.8	20,740	6.9
				15	15.7	24,630	6.88
				17	15.7	29,010	6.91
				19	15.7	33,800	6.94
MOA-471	7/1/03	12.90	10.3 – 19.7	13.5	15.7	19,130	6.81
				15	15.9	24,210	6.89
				17	15.8	29,740	6.95
				19	15.6	30,660	6.97
MOA-472	7/1/03	12.91	10.3 – 19.7	13.5	15.8	20,240	6.8
				15	15.7	22,910	6.87
				17	15.6	25,640	6.89
				19	15.6	26,280	6.89
MOA-473	7/1/03	12.92	10.3 – 19.7	13.5	16.1	17,650	6.73
				15	15.8	25,080	6.84
				17	15.9	28,490	6.83
				19	15.7	29,340	6.86
MOA-474	7/1/03	13.24	10.3 – 19.7	13.5	16	18,010	6.73
				15	15.9	25,560	6.88
				17	15.8	29,140	6.91
				19	15.6	30,960	6.88
MOA-475	7/1/03	13.31	10.3 – 19.7	13.5	16.1	21,430	6.8
				15	16	28,030	6.8
				17	15.8	30,190	6.88
				19	15.7	33,580	6.87
MOA-476	7/1/03	13.4	10.3 – 19.7	14	16.2	21,450	6.75
				15	16.2	27,100	6.74
				17	15.9	33,940	6.81
				19	16	37,260	6.89
MOA-477	7/1/03	13.22	10.3 – 19.7	13.5	16.6	19,640	6.74
				15	16.4	23,720	6.79
				17	16.1	29,250	6.81
				19	16.3	40,320	6.79
MOA-478	7/1/03	13.34	9.6 – 23.9	13.5	16	18,630	6.82
				15.5	15.8	21,610	6.87
				17.5	16.4	25,440	6.93
				19.5	16.3	31,370	6.91
				21.5	16.1	31,520	6.89
				23.3	15.8	31,590	6.9
MOA-479	7/1/03	12.91	9.3 – 23.6	13.5	17.2	19,370	6.97
				15.5	16	19,800	6.83
				17.5	15.8	21,650	6.86
				19.5	15.7	25,580	6.91
				21.5	15.6	27,660	6.93
				23.5	15.5	28,020	6.93

Static WL = Static Water Level below top of casing (TOC) measured on 7/1/2003. TOC elevation is 2-ft above ground level; ft bgs = ft below ground surface.

Table 3-4. Baseline Vertical Profile Field Parameter Results for the Observation Wells

Well	Sample Date	Static WL below TOC (ft)	Screen Interval (ft bgs)	Sample Depth (ft bgs)	Temperature (°C)	Specific Conductance (µS/cm)	pH
MOA-480	7/1/03	14.68	15.5 – 19.8	16	15.9	32,930	7.07
				17.5	15.4	33,970	7.09
				19	15.5	34,110	7.08
MOA-481	7/1/03	14.62	25.4 – 29.7	26	18.5	34,750	7.01
				27.5	17.6	34,750	7
				29	17.2	34,780	7.01
MOA-482	7/1/03	15.73	55.4 – 59.7	56	16.6	110,100	6.92
				57.5	16.5	110,500	6.9
				59	16.4	110,200	6.9
MOA-483	7/1/03	15.06	15.5 – 19.8	16	16.1	25,530	7.04
				17.5	15.9	28,060	6.98
				19	15.8	30,660	6.96
MOA-484	7/1/03	15.22	25.5 – 29.8	26	16.9	35,230	7.06
				27.5	16.8	35,360	7.05
				29	16.6	35,650	7.04
MOA-485	7/1/03	15.34	55.6 – 59.9	56	16.1	110,400	6.91
				57.5	16	110,700	6.91
				59	16.1	111,400	6.92

Static WL = Static Water Level below top of casing (TOC) measured on 7/1/2003. TOC elevation is approximately equal to ground level; ft bgs = ft below ground surface.

Table 3-5. Baseline Sampling Laboratory Results for the Observation Wells

Well	Sample Date	Sample Depth (ft bgs)	Density (g/cm3)	TDS (mg/L)	NH3-N (mg/L)	Cl (mg/L)	NO3 (mg/L)	SO4 (mg/L)	U (mg/L)
MOA-480	7/1/03	17.5	1.0157	22,503	1,100	6,224	115	10,594	4.854
MOA-481	7/1/03	27.5	1.0169	25,978	900	8,165	99	10,955	2.850
MOA-482	7/1/03	57.5	1.0556	85,250	800	47,023	<100	7,224	0.674
MOA-483	7/1/03	17.5	1.0124	20,194	800	4,979	262	10,017	4.211
MOA-484	7/1/03	27.5	1.0173	26,038	900	8,139	106	11,085	4.300
MOA-485	7/1/03	57.5	1.0572	86,260	500	46,987	<100	6,981	0.612

ft bgs = ft below ground surface; TDS = Total Dissolved Solids; NH_3 = Total Ammonia as Nitrogen; Cl = Chloride; NO_3 = Nitrate; SO_4 = Sulfate, g/cm^3 = gallons per cubic centimeter; µS/cm = microsiemens per centimeter; mg/L = milligrams per liter.

Vertical profile data presented in Table 3-3 and Table 3-4 indicate that specific conductance increases with increasing depth at each well location. This trend was expected based on previous investigations completed at the site (DOE 2003a). In general, the specific conductance of the ground water collected from most of the extraction wells ranges from approximately 18,000 microsiemens per centimeter (µS/cm) (at the top of the saturated zone) to 33,000 µS/cm (at a depth of about 19 ft bgs), though, a few wells exceed the high end of this range. For example, the specific conductance of the ground water contained within well MOA-476 increased from 33,940 µS/cm at a depth of 17 ft bgs to 37,260 µS/cm at 19 ft bgs. Well MOA-477 showed a similar result (29,250 to 40,320 µS/cm over the same depths). Both of these wells are located at the northern portion of the well field suggesting the salt-water interface is at a slightly higher elevation than at the southern end.

Ammonia concentrations measured in samples collected from the observation wells range from 500 mg/L to 1,100 mg/L near the center of the well field as evidenced by the data presented in

Table 3-5. The highest ammonia concentrations are from the water samples collected at 17.5 feet below ground surface. Concentrations also appear to be relatively higher for the upgradient (west) observations wells (MOA-480 -481, and –482) than for the wells located down gradient of the extraction well field (MOA-483, -484, and –485).

The second round of sampling and analysis was conducted from July 2 through July 3, 2003 during the aquifer step-tests (Section 3.1.3). All ground water samples were collected during these step-drawdown tests using a suction lift pump with the intake set at 18 ft bgs. Ground water samples were collected from the extraction well discharge at the beginning and end of each test and field measurements were performed for temperature, specific conductance, and pH with a YSI 6920 instrument. These field parameter measurement results are presented in Table 3-6. The ground water sample collected from each extraction well at the end of the 3 gpm step (1st step) was filtered and submitted to the Environmental Science Laboratory (ESL) in Grand Junction, Colorado, for determination of density, total dissolved solids, total ammonia as nitrogen, chloride, nitrate, sulfate, and uranium. These laboratory results are presented in Table 3-7.

Results presented in Table 3-6 indicate that a measurable increase in specific conductance typically resulted from an increase in pumping rate, although the percentage of increase was relatively minor. On average, the specific conductance increased approximately 3,000 µS/cm from the beginning of the 1st step to near the end of the 3rd step, which represents an approximate 10 percent increase. These short-term tests, while they cannot be used to predict long-term response to pumping the aquifer, do suggest minimal brine upconing may occur at increased pump rates for which the system was designed (1 to 7 gpm).

3.2 Evaporation Pond Design

The evaporation pond is designed to evaporate water from the well field at an average rate of 15 gpm for 5 years. Ground water extracted from the well field is piped to a lined evaporation pond located on top of the tailings pile for evaporation. The current configuration of the evaporation pond is shown in Figure 3-1; the construction drawings are presented in Attachment 1. Contaminated ground water discharges to the evaporation pond on the east side of the pond through a perforated pipe to enhance evaporation as the water enters the pond. Ground water collected in the pond is recirculated by spraying the water down an apron on the west slope of the pond to enhance the solar evaporation. A 10 hp centrifugal pump located at the north end of the pond is used to recirculate and spray the pond water down the evaporation apron. The recirculating rate is measured with a flow meter at the centrifugal pump. The treatment capacity may be expanded at a later date by enhancing the evaporation rate through a sprinkler system, which would be located outside the pond on the pile. Appropriate modifications to operating procedures outlined in this section will be made to incorporate changes if the capacity is increased.

3.2.1 Piping

The pipeline for the interim action is grouped into three different systems consisting of (1) well field piping, (2) the main transmission piping from the well field to the pond, and (3) piping for the spray evaporation apron. Design characteristics for each piping system are described in the following sections.

Table 3-6. Results of Baseline Field Parameter Measurements on Samples Collected from Extraction Wells During the Aquifer Step-Tests

Well	Test Date	Static WL (ft bgs)	1st Step[h]						2nd Step[i]						3rd Step					
			Beginning of Step			End of Step			Beginning of Step			End of Step			Beginning of Step			End of Step		
			T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH	T °C	SC (µS/cm)	pH
0470[a]	7/2/03	12.83	18.5	26,320	6.86	17.8	27,140	6.75	15.8	27,060	6.76	15.8	27,450	6.75	15.4	29,970	6.76	15.4	29,330	6.76
0471[b]	7/2/03	13.08	18.4	27,930	6.81	18.2	28,270	6.79	16.1	29,160	6.79	16.2	29,180	6.72	15.7	31,290	6.74	15.7	30,700	6.63
0472[b]	7/2/03	13.19	18.2	23,690	6.67	18	24,110	6.66	16.2	24,960	6.67	16.2	25,160	6.59	15.8	26,820	6.57	15.8	26,360	6.54
0473[c]	7/2/03	13.12	20.2	24,770	6.5	18.6	24,710	6.51	15.9	25,860	6.44	15.9	25,620	6.43	15.5	27,250	6.46	15.5	27,070	6.45
0474[d]	7/2/03	13.45	16.8	25,260	6.61	16.8	25,420	6.66	15.5	25,390	6.71	15.5	25,470	6.74	15.2	26,220	6.77	15.2	26,120	6.78
0475[e]	7/3/03	13.5	17.33	25,010	6.77	17.5	24,990	6.77	15.6	26,920	6.8	15.8	26,480	6.8	na	na	na	15.7	26,970	6.8
0476[f]	7/3/03	13.66	17.5	25,110	6.76	17.9	25,200	6.74	15.9	26,770	6.77	16.1	26,360	6.77	16.2	26,430	6.81	na	na	na
0477[g]	7/3/03	13.46	18	25,220	6.73	18.9	25,240	6.77	16.1	26,620	6.72	16.2	26,680	6.65	15.9	27,930	6.7	16	27,260	6.63
0478[e]	7/3/03	12.84	18.6	22,510	6.72	18.5	23,040	6.68	16.2	24,500	6.68	16.2	24,380	6.68	15.9	25,110	6.69	16	25,170	6.7
0479[g]	7/3/03	12.67	18.2	21,350	6.69	17.9	22,280	6.65	16.1	23,460	6.63	16.1	23,770	6.64	15.9	24,640	6.65	16.1	24,340	6.68

[a] 3rd step completed at 20 gpm
[b] 3rd step completed at 15.5 gpm
[c] 3rd step completed at 14 gpm
[d] 3rd step completed at 15 gpm
[e] 3rd step completed at 12.5 gpm
[f] 3rd step completed at 11 gpm
[g] 3rd step completed at 12 gpm
[h] 1st step conducted at 3 gpm
[I] 2nd step conducted at 10 gpm

T = Temperature; SC = Specific Conductance; beginning of step data collected within first 5 min of step; end of step data collected within last 5 min of step; na = data not available

Table 3-7. Results of Baseline Laboratory Analysis on Samples Collected from Extraction Wells at the end of the 3 gpm Aquifer Step-Test

Well	Sample Date	Density (g/cm3)	TDS (mg/L)	NH3-N (mg/L)	Cl (mg/L)	NO3 (mg/L)	SO4 (mg/L)	U (mg/L)
0470	7/2/03	1.0149	20,387	1,000	5,357	195	10,023	3.741
0471	7/2/03	1.0142	21,061	950	5,902	145	10,038	3.360
0472	7/2/03	1.0125	18,434	850	4,403	166	9,461	3.503
0473	7/2/03	1.0131	18,856	700	4,507	184	9,721	4.163
0474	7/2/03	1.0124	19,372	850	4,774	164	9,832	4.086
0475	7/3/03	1.0134	19,471	800	4,822	182	9,975	3.868
0476	7/3/03	1.0139	19,203	1,050	4,755	125	9,865	3.595
0477	7/3/03	1.0142	20,168	700	4,821	90	10,062	4.484
0478	7/3/03	1.0132	18,226	650	3,669	116	9,872	3.917
0479	7/3/03	1.0134	17,640	700	3,424	110	9,797	5.229

Note: The pump intake was set at a depth of 18 ft bgs at each location.
TDS = Total Dissolved Solids; NH_3 = Total Ammonia as Nitrogen; Cl = Chloride;
NO_3 = Nitrate; SO_4 = Sulfate; U = Uranium; g/cm^3 = grams per cubic centimeter; mg/L = milligrams per liter.

3.2.1.1 Well field piping

- Each well discharges into a 1 1/4-inch diameter Sch. 80 PVC pipe which is designed to accept a flow of 18 gpm at 5 feet per second velocity. This pipe connects to the well field header pipe.
- The well field header pipe is a 2 1/2 inch diameter Class 160 PVC pipe that runs parallel to the wells and collects water from each well. The well field header pipe is designed to accept a flow of 85 gpm at 5 feet per second velocity.
- At the end of the well field header pipe, downstream of the last well pipe tie-in, a magnetic flow meter is located which measures instantaneous and cumulative flow from the well field. This meter is referred to as the Badger totalizer.
- The well field header pipe ties into the main ground water transmission line downstream of the flow meter.
- All well field piping is buried 2 feet – 6 inches below grade to prevent from freezing.

3.2.1.2 Main Ground Water Transmission Line

- The main transmission line consists of a 4-inch diameter, Class 160 PVC pipe that is designed to allow flow of 200 gpm at 5 feet per second velocity. The greater flow for the main transmission line as compared to the well field piping is designed to be flexible to allow for a future expansion of the well field of up to an additional 115 gpm (200 gpm – 85 gpm).
- The transmission piping is above ground resting directly on grade and held in place by steel stakes at 20 feet on center.
- The pipe runs up the side of the tailings pile to the top of pond berm and tees (┬) into a 4 inch diameter perforated discharge pipe, 20 feet on each side of the transmission pipe. The discharge pipe is perforated with ½ inch diameter holes at 1 foot intervals that allows the ground water to discharge and spread across the slope of the pond providing additional heating and evaporation from the pond liner.
- Combination air release and vacuum valves are located at high points on the transmission line to prevent cavitation.

- Drains are located at low points on the transmission line to allow draining for winter shutdowns or repairs if necessary.

3.2.1.3 Apron Spray Piping System

- The recirculation pump piping discharges into the spray system piping.
- Directly downstream of where the 3-inch pipe for the flow meter expands to 6-inch diameter PVC, a drain valve and flow control valve are located. The drain valve allows the entire spray system to be drained while the flow control valve controls flow to the apron spray system.
- The spray system supply line runs along the pond edge to the end of the apron where it elbows and runs parallel along the top edge of the apron.
- Six spray bars are evenly spaced along the top edge of the apron and tee off of the supply line.
- Each spray bar is 2-inch diameter Sch. 40 PVC with ½ inch diameter holes drilled at 1 foot intervals.
- Each spray bar has bolted blind flanges at the ends to allow ease in removal for pipe access for cleaning.
- The spray bars are connected to the supply line with a 2-inch diameter Sch. 40 PVC pipe with a 2-inch butterfly valve on it. The valve allows flow control to each spray bar since optimal operation is to have each spray bar discharge the same amount of water.
- The entire spray system supply line and spray bars are located above ground resting directly on grade and supported in-place by metal stakes.
- 2-inch gate valves are located on the supply line at each of the six spray bar locations. These gate valves will provide hose hookups for future spraying of the apron to clean up anticipated residue build up.

3.2.2 Pond Construction and Capacity

The pond is constructed by a combined excavation and berm construction using a cut and fill method. All earthen material used in the pond construction was obtained from existing material from the top of the pile. The dimension of the pond bottom is 12 feet wide by 615 feet long and is 11.6 feet below the top of the pond berm. The apron slopes 6 percent from the bottom of the pond to the top of the berm. The other three sides slope up from the bottom at 3 horizontal to 1 vertical to the top of the berm.

The northwest and northeast berms are 12 feet wide to allow placement and access to the spray system piping while the remaining berms are 8 feet wide. The east corner top of berm is widened to 50 feet wide by 80 feet long to provide a location for the recirculation pump and pond access. The outside slopes of the pond are at 3 horizontal to 1 vertical and tie into the existing grade.

The entire inside of the pond and the interior side slopes are covered with black 40 mil HDPE liner that adsorbs solar radiation and thus increases the evaporation rate. The pond liner is held in place by 50 pound sand bags while the side slopes are held down by sand filled 6-inch diameter ballast tubes. Sand bags and ballast tubes are constructed from 45-mil SCRIM reinforced polypropylene.

The capacity of the pond is a function of water depth. Water depth, elevation, surface area, volume, and freeboard are summarized in Table 3-8. The capacity of the evaporation pond with two feet of freeboard is approximately 5,000,000 gallons at a water depth of 9.6 feet. The pond volume and surface area as a function of water depth are shown in Figure 3-2 and Figure 3-3, respectively.

Table 3-8. Pond Elevation, Surface Area, Volume, and Freeboard as a Function of Depth

Depth (ft)	Elevation (ft)	Surface Area (ac)	Cumulative Volume (gals)	Freeboard (ft)
0.00	4,048.4	0.0	0.0	
0.50	4,048.9	0.3	38,981	
1.00	4,049.4	0.5	101,189	
1.50	4,049.9	0.6	186,826	
2.00	4,050.4	0.7	295,892	
2.50	4,050.9	0.9	429,195	
3.00	4,051.4	1.0	586,735	
3.50	4,051.9	1.2	767,905	
4.00	4,052.4	1.3	972,909	
4.50	4,052.9	1.5	1,201,543	
5.00	4,053.4	1.6	1,454,011	
5.50	4,053.9	1.8	1,732,331	
6.00	4,054.4	2.0	2,037,312	
6.50	4,054.9	2.1	2,367,943	
7.00	4,055.4	2.3	2,724,024	
7.50	4,055.9	2.4	3,105,755	
8.00	4,056.4	2.6	3,514,954	
8.50	4,056.9	2.8	3,952,026	
9.00	4,057.4	2.9	4,417,980	
9.60	4,058.0	3.1	5,015,015	2
10.00	4,058.4	3.3	5,435,323	
10.60	4,059.0	3.5	6,098,606	1

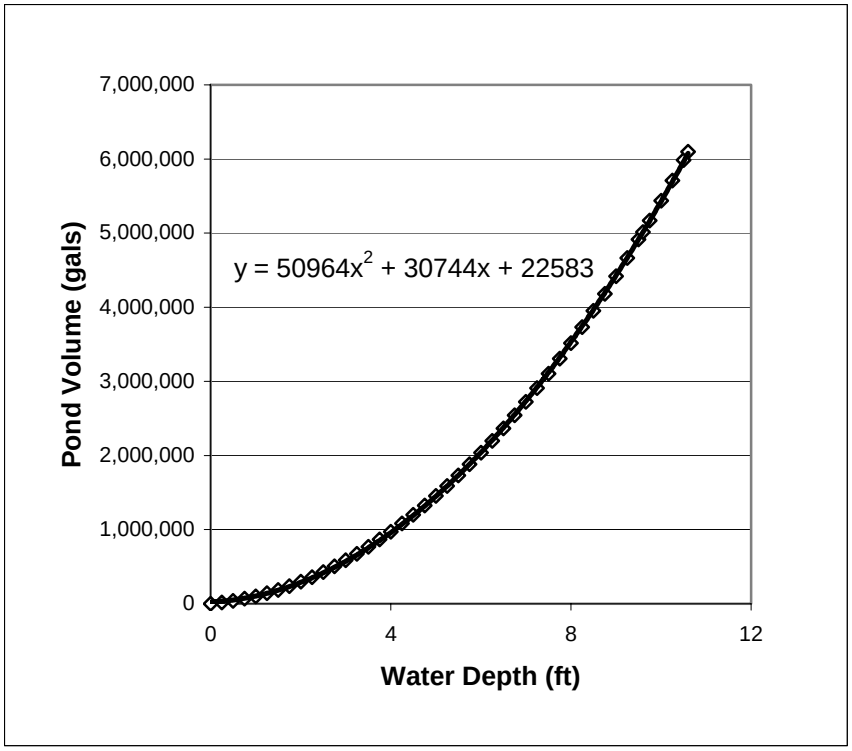


Figure 3-2. Volume of the Evaporation Pond as a Function of Water Depth

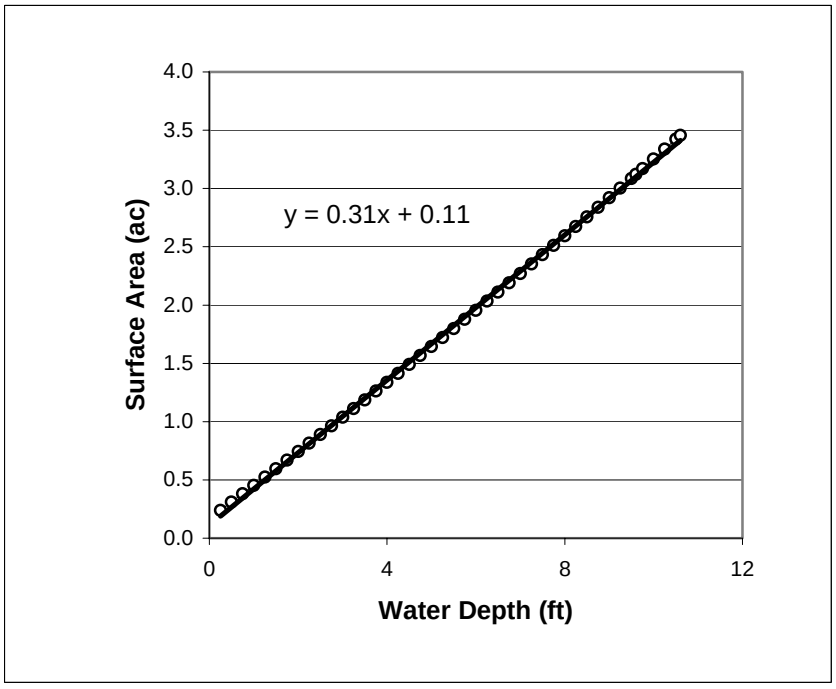


Figure 3-3. Surface Area of the Evaporation Pond as a Function of Water Depth

3.2.3 Recirculating Pump

The recirculating pump supplies water to the apron spray piping system. The recirculation pump consists of a 10 HP, 3-phase electric motor centrifugal pump mounted on a steel skid. Electric pump controls are also mounted on the steel skid.

The recirculation pump suction line is mounted on a buoy that allows the pump intake to be fixed at a depth of approximately 1 foot from the bottom of the buoy. The buoy is constructed of 8-inch diameter Sch. 40 PVC banded together with galvanized metal strapping. A 4-inch diameter aluminum foot valve attached to the suction intake maintains water and prime in the pump. A 24-inch diameter intake cage constructed of perforated HDPE with an HDPE solid bottom allows the cage to rest directly on the pond bottom when the pond water level is 2-feet or less in depth. The perforations allow water inflow, but keep large matter away from the suction intake.

The suction line is connected to the recirculation pump by a 4-inch diameter rubber water suction hose, which is designed to be flexible as the pond water levels rise and drop. The recirculation pump discharges into a 3 inch black rubber discharge hose which is connected to the recirculation piping. All connections to the pump and to the suction end buoy are equipped with cam-lock quick disconnects to allow ease in removal and replacement for maintenance.

The discharge hose connects to a 3 inch diameter Sch. 80 PVC pipe which has a 3 inch magnetic flow meter and pressure gauge located on it. The meter measures instantaneous flow rate and cumulative volume from the pump while the pressure gauge measures water pressure. These are used to control flow through the system and to monitor pump performance. Downstream of the flow meter the piping expands to the 6-inch diameter Sch. 40 PVC spray system supply line.

End of current text

4.0 Operation Requirements

4.1 Inspection Days

Routine inspections shall be conducted two times each week (Monday and Thursday). As the system becomes more understood and reliable, routine inspections may be conducted less frequently, as established by the Ground Water Manager. Conversely, inspections may be required more frequently depending on the specific objectives of a particular hydrologic test that may be performed as part of an observational approach to optimize the system design and effectiveness.

If a holiday occurs on a Monday, the routine inspection shall take place on the first business day after the holiday. If a holiday occurs on a Thursday, the routine inspection shall take place on the first business day prior to the holiday. Inclement weather conditions, such as heavy rain or snow, may infrequently delay an inspection. If the weather conditions deteriorate to the point that fieldwork is neither safe nor practical during a scheduled inspection, the inspection shall be conducted on the first unaffected following business day.

4.2 Pond Levels

Utah Water Quality rules require wastewater disposal ponds to maintain a minimum freeboard to prevent overtopping and related spills or dike failure [see UAC R317-3-10.3(C)]. A 3-foot freeboard is required for disposal ponds that manage more than 35 gpm. A 2-foot freeboard is required for ponds that manage less than 35 gpm. Operation of the interim action pond is intended to be consistent with these parameters.

4.3 Treatment Rates

The current configuration of the pump and treat system is designed to treat contaminated ground water at an annual average rate of 15 gpm with higher rates in the summer during periods of greater evaporation capacity and to be shut off in the winter when the pond reaches a water depth of approximately 4-feet during periods of minimal to no evaporation. However, during operations in 2003 the well field was operated at rates up to 30 gpm before shutting the system off on December 27 when the pond level reached a depth of approximately 8.1 feet. This depth represents the starting conditions for 2004. Flow rates less than 15 gpm will be required in 2004 to reduce the depth of water in the pond before the system can be operated at higher rates, unless additional evaporative capacity can be added to the system.

The projected pumping rates by month for 2004 is presented in Table 4-1 and provides initial operating flow rates for the well field for routine operations. These initial well field operating flow rates will be modified as experience with the system is gained or modified based on specific objectives of a particular test that may be performed as part of the observational approach to optimize the system design and effectiveness. The flow rates may also be increased in 2004 if the evaporative capacity of the pond is enhanced by construction of a sprinkler system.

Table 4-1. Initial Operating Conditions for the Interim Action in 2004

Month	Pumping Rate (gpm)	Projected Evaporation Rate (gpm)	Projected Pond Depth (ft)
January	0	1.9	8.1[a]
February	0	3.4	8.0
March	10	5.8	8.4
April	10	8.8	8.5
May	10	11.9	8.5
June	10	14.8	8.3
July	10	15.5	8.0
August	10	13.5	8.0
September	10	9.9	8.1
October	10	6.0	8.4
November	0	3.1	8.3
December	0	1.8	8.3

[a] Depth of water remaining in pond when operations were shut off for the winter on December 27, 2003

4.4 Personnel and Equipment

Only one Operator is required to conduct each inspection. The Operator will perform miscellaneous minor repairs. Major repairs to the system will be made by subcontractors who will furnish their own appropriate equipment and tools. The Operator will be supplied with a cellular telephone or a two-way radio for safety and emergency.

Equipment and material cutsheets are provided in Appendix D.

4.5 Environmental Compliance

Additional information (from that given in this section) on environmental compliance, waste management, and emergency response is in the Moab HSP (DOE 2003b).

Extraction well and spray pumps require periodic repair or replacement. When the Operator removes a pump from an extraction well or the spray pump from the evaporation pond, the Moab RCT (Site Safety Coordinator) shall perform a radiological survey (both interior and exterior, as appropriate) and document the free release of the pump prior to release from the site.

Low volumes of waste water will be generated from sampling and well maintenance activities in the well field. Low volumes of purge water from sampling and well maintenance will be managed by spreading the ground water evenly on the ground surface in a circle around the well. If 30 gallons or less of purge water are generated, the water will be dispersed in a circle with a radius of at least 2 feet. If greater than 30 gallons of purge water are generated, the water will be dispersed in a circle with a radius of at least 15 feet. This will prevent ground water contaminants from accumulating to unacceptable levels in soils that are not contaminated.

Aquifer testing generates relatively large volumes of waste water. Ground water effluent from aquifer testing activities at the extraction well field will be managed by piping the ground water to a controlled area on the site and then discharging the ground water on the surface to areas that

are surface contaminated. Waste water will not be dispersed onto surface areas that will enable the water to flow into Moab Wash or the Colorado River.

4.6 Health and Safety

Additional information (from that given in this plan) on health and safety, and emergency response is in the Moab HSP (DOE 2003b). The site-specific HSP has been prepared for the Moab Project in accordance with the requirements of 29 CFR 1910.120. All operations, inspections, maintenance, and monitoring for the ground water interim action will be performed according to the site-specific health and safety requirements developed for this task (DOE 2003b).

4.7 Quality Assurance

All personnel that will conduct operations, monitoring, and maintenance of the ground water remediation system are required to read and understand these procedures and sign a copy of the "Statement of Understanding" (Appendix D), of these procedures.

4.8 Training

Operations, maintenance, and performance monitoring training will be performed on site by qualified individuals familiar with these procedures and are competent according to Occupational Safety and Health Administration (OSHA) requirements to perform the work. Additional training, such as site safety briefing, job safety hazards, and hazard communication briefing are specified in the Moab HSP.

End of current text

5.0 Operating and Maintenance Procedures

The purpose of this section is to establish the procedures for operating the pumps and spray system that comprise the ground water Interim Action system at the Moab site. These procedures when correctly carried out prevent accidents and injuries; ensure proper operation and record keeping of the pump and treat system. On-site personnel will inspect and ensure the system is functioning correctly and that appropriate maintenance and repairs are made.

5.1 General

The pumps for the well field and spray system for the evaporation pond operate continuously. If an extraction pump is not operating and the well is not in a recovery mode between pumping cycles, there is a problem with the system and it should be shutdown according to the procedure in Section 5.2.1.3. The Operator is authorized to shutdown and/or start pumps or systems to perform a pump filter change out according to Section 5.2.1.2, if the Site Manager has directed maintenance or repair work, or an emergency requires a shutdown. The Moab Ground Water Manager will direct all other start-ups, shutdowns, or changes in operating conditions based on specific project objectives.

Emergency shutdowns require immediate notification according to the Moab HSP (DOE 2003b). Examples of emergencies are accident, vandalism, severe weather damage, or system component failure. If there is any question or doubt as to whether to initiate a shutdown or the procedure to effect a shutdown of the entire system or an individual pump or system, contact the Ground Water Manager, Site Manager, or Project Engineer at the telephone numbers provided for selected Stoller personnel in Table 2-1.

5.2 Well Field Procedures

5.2.1 Well Pumps

5.2.1.1 Start Up

The extraction well pumps should be started against a slight head. The discharge valve should be closed one-third (⅓). The main power switch at the power pole is switched on. The breaker box in the electrical panel board should be opened to ensure all the required breakers are at the on position. Individual pumps can be switched on at the switch panel. Each pump switch is labeled after the well number the pump is installed in (i.e., MOA-470 to –479). As each pump is switched on its pressure gauge and flow meter are monitored. The discharge valve to the header manifold is adjusted to allow the maximum flow that provides steady operation. Typically the pressure at each well is approximately 100 to 140 psi. The flow rate is adjusted between 1 to 7 gpm depending upon specific operating requirements provided by the Moab Ground Water Manager at the time. Steady operation is indicated if the pump runs quietly without surging or cutting out. Once each pump operation steadies down the flow rate and pressure should be logged.

5.2.1.2 Normal Operation

The pumps will normally run continuously with out any adjustment required. However if there are signs of surging the discharge valve may need to be closed more. If the flow rate falls off the discharge valve should be opened until surging occurs at which point it should be closed slightly until steady operation is achieved. If the pump shuts down wait until it restarts automatically after 15-minutes and then adjust the discharge valve to get steady operation.

If the flow drops off more than 1 gpm and opening the discharge valve does not improve it then the filter is blocked and needs to be cleared. The valve on top of the filter should be opened slowly and sediment flushed out. CAUTION! Pressure should be released slowly. WEAR A FACE SHIELD. Avoid getting sprayed in the face. If after flushing the filter the flow does not recover then the filter needs cleaning.

Cleaning the Filter

The pump must be shut down and the discharge valve closed. The filter relief valve is opened to relieve the residual pressure. The filter housing can then be unscrewed and the filter removed for cleaning. After cleaning and replacing the filter, the pump should be started up according to Section 5.2.1.1.

Pump Failure

If a pump shuts down and fails to restart after 15 minutes the breaker should be checked. If the breaker is still in the on position or if it shuts off again immediately, the breaker should be switched permanently off and the Site Manager informed.

5.2.1.3 Shut Down

The pumps can be shut down by switching them off at the switch panel. The discharge valve should be closed as a precaution in case the check valve at the header bypasses. If the main header leading to the pond is shutdown during freezing conditions it should be drained at the valve just down stream from the totalizer (Badger meter) and at the low point on the line before it goes up the side of the tailings pile. Also, the individual well pump discharge lines should be drained during freezing conditions.

5.2.2 Well Development

An extraction well may lose efficiency after a period of time. Increased drawdown and pump shut down are indications that a well may need to be redeveloped. When the extraction wells were first installed, less than 1 ft of drawdown was measured while pumping 3 gpm at each location. After five months of pumping, the majority of the extraction wells were experiencing over 2 ft of drawdown with a pumping rate of 2 gpm. While there was a significant drop in the river stage (which controls the saturated thickness), which may explain some of the reduced well performance, the increase in drawdown is largely a result of a decrease in well efficiency.

In order to increase and maintain well efficiency, additional well development will be required. Prior to the startup of the extraction well field after the winter shutdown, each extraction well

will be developed using surging, high velocity jetting, and air lift development techniques. During development, chemicals specially designed to increase well efficiency may be used to control mineral buildup on the screen (acids), reduce biological growth inside the well sumps (bioacid dispersants), and remove clay from the sand pack (clay dispersants). Well performance will dictate when additional well development is necessary.

5.3 Evaporation Pond Procedures

5.3.1 Spray Pump

5.3.1.1 Start Up

There must be at least 2 feet of water in the pond before start up of the spray system.

Open all the 2-inch spray header valves and close the drain valves. The spray pump must be primed before attempting to start it. This can be accomplished by removing the 1-inch plug on top of the pump and adding water till the pump and suction pipe are full. The discharge valve should be ¾ closed. The pump is then started by holding in the start button and turning the switch to manual. Once the pump starts pumping the discharge valve can be slowly opened until the pressure gauge reads 10 psi. The individual spray header valves should then be adjusted so that all the sprays are operating. The header valves nearest the pump would be partly closed while the valves furthest away would be wide open. By adequate adjustment an even flow of water emanating from the sprays can be achieved thus enhancing the evaporation rate.

5.3.1.2 Normal Operation

Adjustments to the amount of water being pumped should only be made if the pond level is getting too low or too high. If the water level in the pond decreases to less than 2-feet in depth, then the recirculating spray pump will cavitate due to the increased suction. Thus, the spray pump should be turned off until the pond level rises to operating levels. To maintain the water level above the 2-foot depth, the flow rate from the well field may need to be increased or the spray pump rate decreased.

If the influent rate of contaminated ground water from the well field is greater than the evaporation rate, then the pond could overfill its capacity or exceed the minimum freeboard (Section 4.2). Thus, the flow rate from the well field should be reduced. Alternatively, it may be possible to lower the water level in the pond by increasing the spray pump rate. In all cases, a minimum of 3-foot of freeboard is required when the system is operating at greater than 35 gpm from the well field and a minimum of 2-foot of freeboard is required when the system is operating at less than 35 gpm from the well field.

5.3.1.3 Shut Down

The spray system is shut down simply by turning off the spray water recirculation pump. If this occurs during freezing conditions then the pump and lines should be drained by opening all the drain valves.

5.4 Winterization

The well field and spray pumps will have to be shut down during times of extremely low temperatures in order to protect the system from damage due to freezing. Such conditions are normally encountered during December and January. Also, if the weather forecast indicates temperatures below freezing during the day as well as night or that night time temperatures will fall below 20 degrees Fahrenheit then winterization precautions need to be put into effect. The lines will have to be drained using the drain valves on the main header leading to the pond and at the individual well pumps. Also, the spray header drain valves need to be opened. The spray pump should also be drained.

5.5 Safety

The well pumps are powered by a 110-volt single-phase supply. The spray water recirculation pump is supplied by 440 volt three phase current. Lock out / Tag out procedures must be followed any time the pumps are being worked on.

Valves closed against lines under pressure should be tagged shut.

The Moab RCT (Radiological Control Technician) should perform a radiation survey anytime a pump is removed for maintenance or replacement to check for contamination (see Section 4.5).

6.0 Performance Monitoring and Record Keeping

Monitoring data collected during operations of the interim action will be used to evaluate the performance of the system. Water level and water quality measurements will be performed at the evaporation pond, the well field, and at one surface water location. Ten extraction wells, six observation wells, and selected existing monitor wells will be included as performance wells. Flow rates, cumulative volumes, and pressures will be recorded.

The Operator is responsible for completing the interim action worksheets (Appendix F) of these procedures as a record of inspection, maintenance, sampling, and operations of the pump and treat system. These worksheets shall be faxed on the day it is completed to the Contractor to the attention of Kym Bevan at fax number (970) 248-7636, office telephone number (970) 248-6743.

A schedule for monitoring the operating parameters of the interim action is summarized in Table 6-1. A schedule for sampling and analysis of water samples collected from wells, at the surface water location, and from the evaporation pond is summarized in Table 6-2. The schedules presented in Table 6-1 and Table 6-2 will be reevaluated after data history is established. Descriptions of the data collection requirements for each parameter are provided in the sections below.

6.1 Water Levels

One objective of the extraction system is to manipulate the ground water gradient to minimize the discharge of contaminated water to the river. The hydraulic effect of this will be verified by measuring water depths at all the extraction wells, all the observation wells, and at two existing monitor wells. The depth of water in the evaporation pond will be monitored to evaluate the evaporation rate and to monitor the freeboard. Water level measurements will be collected according to the schedule provided in Table 6-1.

Depth to ground water for the wells are measured manually with an electronic tape from the top of casing. Total depth of the water in the evaporation pond is measured directly from a scale on the staff gage. Additional requirements for specific locations requiring water depth measurements are listed in Table 6-3. Locations are shown in Figure 6-1. A worksheet to record the water levels is provided in Appendix F. Water levels measured for the wells will be recorded to the nearest 0.01-foot. Water levels measured at the staff gage will be recorded to the nearest 0.25-foot.

6.2 Flow, Volume, and Pressure Measurements

Flow rate, volume, and pressure measurements to monitor the performance of the well field will be recorded manually according to the schedule in Table 6-1. Measurements in the well field will be collected at meters installed at each individual extraction well and at the totalizer (Badger meter) that measures combined effluent from all the extraction wells. Flow rate and pressure measurements will be collected at the evaporation pond recirculating spray pump. A worksheet to record the measurement is provided in Appendix F. Measurement locations referenced in Appendix F are illustrated in Figure 6-1.

Table 6-1. Interim Action Data Collection Schedule for Operating Parameters

Location	Pre-startup (March 2004)				Startup (March 2004)				Operations (2004)			
	Water Level	Flow Rate	Volume	Pressure	Water Level	Flow Rate	Volume	Pressure	Water Level	Flow Rate	Volume	Pressure
Extraction Wells	One time event	One time event	One time event	One time event	One time event	One time event	One time event	One time event	Twice per week	Twice per week	Twice per week	Twice per week
Observation Wells	One time event	NA	NA	NA	One time event	NA	NA	NA	Twice per week	NA	NA	NA
Monitor Wells	One time event	NA	NA	NA	One time event	NA	NA	NA	Twice per week	NA	NA	NA
Evaporation Pond	One time event[a]	NA	NA	NA	One time event	One time event	NA	One time event	Twice per week	Twice per week	NA	Twice per week

NA; not applicable

[a] Approximately 8-feet of water remaining in pond when operations were shut off for the winter on December 27, 2003

Table 6-2. Interim Action Data Collection Schedule for Water Sampling and Analysis

Location	Pre-startup (March 2004)		Startup (March 2004)		Operations (2004)	
	Field Parameters	Laboratory Analysis	Field Parameters	Laboratory Analysis	Field Parameters	Laboratory Analysis
Extraction Wells	One time event	One time event	One time event	One time event	Twice per week	Monthly
Observation Wells	One time event	One time event	One time event	One time event	Monthly	Monthly
Monitor Wells	One time event	One time event	One time event	One time event	Monthly	Monthly
River	One time event	One time event	One time event	One time event	Monthly	Monthly
Evaporation Pond	One time event[a]	One time event [a]	One time event	One time event	Twice per week	Monthly

[a] Approximately 8-feet of water remaining in pond when operations were shut off for the winter on December 27, 2003

Table 6-3. Water Level Measurement Locations and Requirements

Location	ID	Purpose	Frequency
Extraction well	MOA-470 through -479	Monitor drawdown	Before extraction pump is turned on and two times a week. When flow rates are changed.
Observation well	MOA-480 through -485	Monitor capture zone	Before extraction pumps are turned on and two times a week. When flow rates are changed.
Monitor well	MOA-403 and -407	Monitor baseline	Before well field pumps are turned on and two times a week. When flow rates are changed.
Evaporation pond	Staff gage	Monitor pond volume and freeboard	Before well field pumps are turned on and two times a week. When flow rates are changed.

6.3 Field Parameters

Field measurements of temperature, specific conductance, and pH performed on ground water samples collected from the effluent at each extraction well, at the surface water location, and on samples collected from the evaporation pond water will be performed according to the schedule presented in Table 6-2. Specific locations at the well field and the evaporation pond are provided on a worksheet in Appendix F to record the field parameter measurements. A worksheet to record the calibration of the YSI specific conductance probe used to perform the measurements is provided in Appendix F. Measurement locations referenced in Appendix F are illustrated in Figure 6-1.

6.4 Laboratory Sampling and Analysis

Filtered water samples will be collected from the extraction wells, observation wells, two existing monitor wells, one surface water location, and from the evaporation pond according to the schedule presented in Table 6-2. Specific locations to be sampled are listed in Table 6-4. Water Sample Locations for Laboratory Analysis and shown in Figure 6-1. Interim Action Sampling and Analysis Worksheets are presented in Appendix G.

Table 6-4. Water Sample Locations for Laboratory Analysis

Location	ID	Purpose	Frequency
Extraction well	MOA-470 through -479	Monitor changes in plume concentrations and upcoming.	Before and after well field pumps are turned on at startup and monthly thereafter.
Observation well	MOA-480 through -485	Monitor changes in plume concentrations and upcoming.	Before and after well field pumps are turned on at startup and monthly thereafter.
Monitor well	MOA-403 and -407	Monitor reduction of plume concentrations downgradient of well field near river.	Before and after well field pumps are turned on at startup and monthly thereafter.
River	MOA-216	Monitor changes in water quality downgradient of well field at river.	Before and after well field pumps are turned on at startup and monthly thereafter.
Evaporation pond	Inlet and discharge pipe from recirculating pump	Monitor changes in pond concentrations.	Before and after well field pumps are turned on at startup and monthly thereafter.

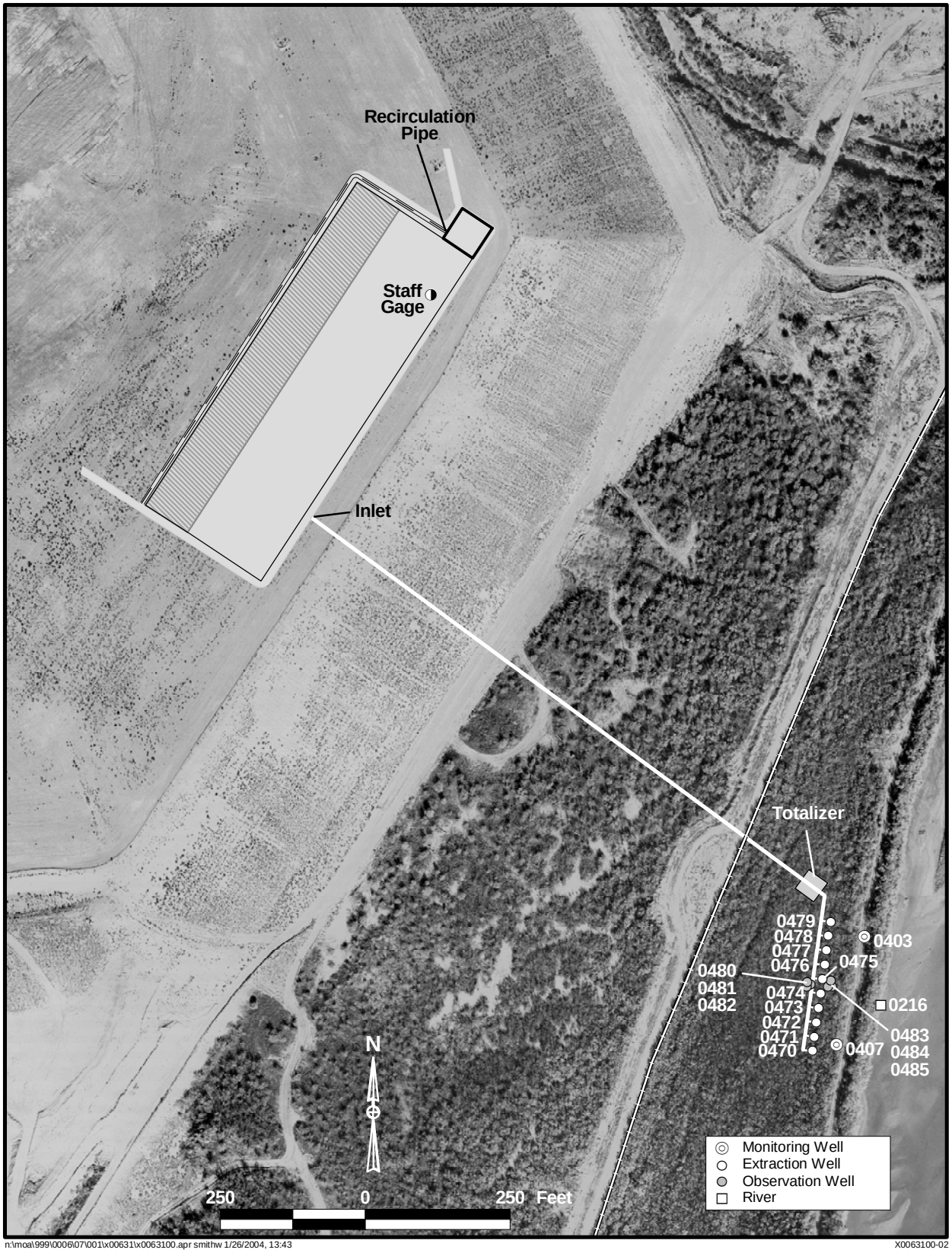


Figure 6-1. Sample and Measurement Locations

Water samples will be submitted to a commercial laboratory for analyses of the constituents listed in Table 6–5. More extensive sampling may also be conducted on an as needed basis at selected locations in the system or at new monitoring locations established at a later date to monitor the effectiveness of the interim action.

Table 6-5. Analytes and Methods for Ground Water and Evaporation Pond Samples

Analyte	Sample Container	Preservation	EPA Method	Detection Limit	Line Item Code (LIC)
Ammonia- N	125 mL poly	HNO_3, pH < 2	350.3	0.1 mg/L	WCH-A-006
Chloride	500 mL poly	Cool, 4° C	300	0.5 mg/L	WCH-A-011
Sulfate			300	5 mg/L	WCH-A-036
TDS	125 mL poly	Cool, 4° C	160.1	10 mg/L	WCH-A-033
Uranium	500 mL poly	HNO_3, pH < 2	GJO-1	0.1 µg/L	GJO-1

6.4.1 Sampling Procedures

Water sampling will be performed in accordance with the *Sampling and Analysis Plan for the UMTRA Ground Water Project* (DOE 2002) and the *Grand Junction Office Environmental Procedures Catalog* (GJO 6). Deviations from these procedures will be noted in a field variance log with an explanation and a description of its possible impacts on data quality. The following specific procedures from the Environmental Procedures Catalog will be used for water sampling:

- GT-1(P), "Standard Practice for Field Documentation Processes."
- GT-2(P), "Standard Practice for Sample Labeling."
- GT-3(P), "Standard Practice for Chain-of-Sample-Custody and Physical Security of Samples."
- LQ-2(T), "Standard Test Method for the Measurement of Water Levels in Ground Water Monitoring Wells."
- LQ-3(P), "Standard Practice for Purging Monitoring Wells."
- LQ-4(T), "Standard Test Method for the Field Measurement of pH."
- LQ-5(T), "Standard Test Method for the Field Measurement of Specific Conductance."
- LQ-6(T), "Standard Test Method for the Field Measurement of the Oxidation-Reduction Potential (Eh)."
- LQ-7(T), "Standard Test Method for the Field Measurement of Alkalinity."
- LQ-8(T), "Standard Test Method for the Field Measurement of Temperature."
- LQ-9(T), "Standard Test Method for the Field Measurement of Dissolved Oxygen."
- LQ-10(P), "Standard Practice for the Use of a Flow Cell for Field Measurements."
- LQ-24(T), "Standard Test Method for Turbidity in Water."
- LQ-11(P), "Standard Practice for the Sampling of Liquids."
- LQ-12(P), "Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples."

- LQ-19(P), "Standard Practice for the Inspection and Maintenance of Ground water Monitoring Wells."

6.4.2 Sample Quality Assurance and Control

The objective of sample quality assurance and control measures is to provide systematic control of the tasks so as to maximize accuracy, precision, comparability, and completeness. All procedures will be checked for accuracy through internal laboratory quality control checks such as the analysis of blind duplicates, splits, and known standards. A minimum of 10 percent of the samples submitted for laboratory analysis will be field quality-control samples. Field quality control samples may include equipment rinsate blanks, check samples, trip blanks, and duplicates. These samples will be submitted for the same analyses as the other field samples. Analytical methods to be used for the water samples are summarized in Table 6-4. Sample preservation will consist of storing the samples in a cooler with ice during field sampling, sample packaging, and shipping.

To maintain evidence of authenticity, the samples collected must be properly identified and easily discernible from other like samples. A label will be attached to the sample container specifying the sample identification number, location, date collected, time collected, and the sampler's name.

Water samples will be kept under custody from the time of collection to the time of analysis. Chain-of-custody records will be used to list all transfers in the possession of the samples. The chain-of-custody form will show that the sample was in constant custody between collection and analysis. While the samples are in shipment to the analytical laboratory, custody seals will be placed over the cooler opening to ensure that the integrity of the samples have not been compromised. The receiving laboratory must examine the seals on arrival and document that the seals are intact. Upon opening the container, the receiving laboratory will note the condition of the sample container (e.g. broken bottles, leaking bottles, etc.).

All sample shipments will be made in compliance with Department of Transportation regulations (49 CFR 171-179) governing shipment of hazardous materials and substances. These regulations govern the packaging, documentation, and shipping of hazardous material, substances, and waste. Special care will be taken to ensure the integrity of the sample through proper packaging and shipping. To determine the proper identification of a hazardous sample, field personnel will review field measurements data and field notes for relevant information concerning the sample material in a container. This information will include field radiological scans and any other information that might be useful in classifying the sample for shipment. If a sample is known or suspected to contain a specific hazardous material, the sampler will note its presence on the sample label. This information is important to the receiving laboratory to determine the proper handling of the sample prior to its analysis.

7.0 References

DOE (U.S. Department of Energy), 2002. *Ground Water and Surface Water Sampling and Analysis Plan for GJO Projects*, Rev. 6, G JO−2003−402−TAC, U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2003a. *Site Observational Work Plan for the Moab, Utah, Site*, GJO-2003-424-TAC, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2003b. *Moab Project Site Health and Safety Plan*, GJO-2003-389-TAC, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2003c. *Moab Project Site Ground Water Interim Action Remediation Construction Specifications*, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

GJO 6. *Grand Junction Office Environmental Procedures Catalog*, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, continuously updated.

End of current text

Appendix A

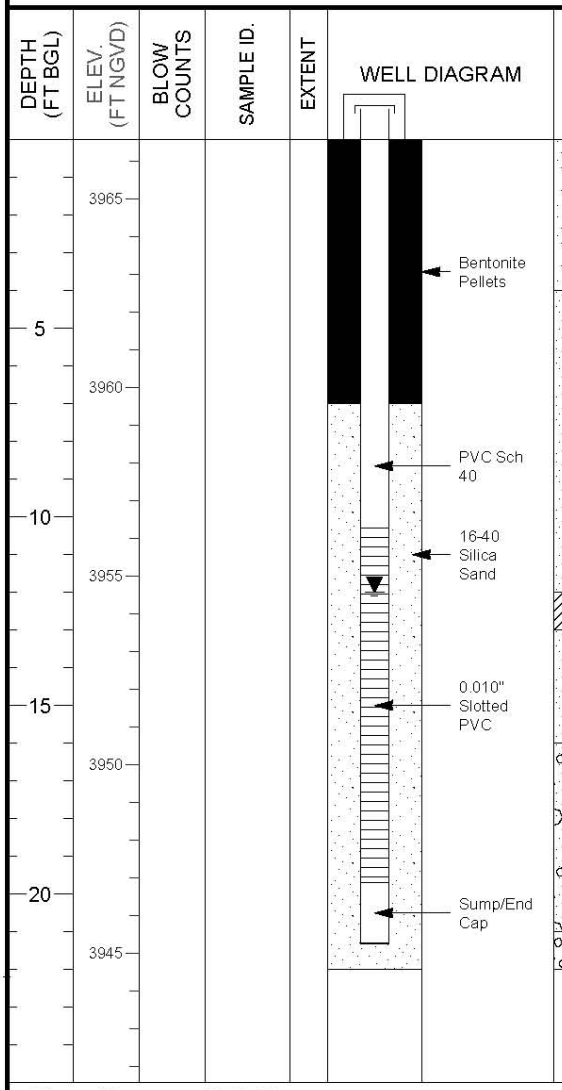
Well Boring and Construction Logs

MOA01-0470

PROJECT	MOAB	**NORTH COORD. (FT)**	6663337.05	**DATE DRILLED**	06/25/2003
LOCATION	Moab, UT	**EAST COORD. (FT)**	2185988.21	**SURFACE ELEV. (FT NGVD)**	3966.56
SITE	MOAB	**HOLE DEPTH (FT)**	22.00	**TOP OF CASING (FT)**	3966.41
WELL NUMBER	0470	**WELL DEPTH (FT)**	21.30	**MEAS. PT. ELEV. (FT)**	3966.41
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	9.0 / / 6.0

WELL INSTALLATION		**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	0.15	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/25/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.

4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.

12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.

13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.

16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.

21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.

Total Depth 22.0 ft.

MOA01-0471

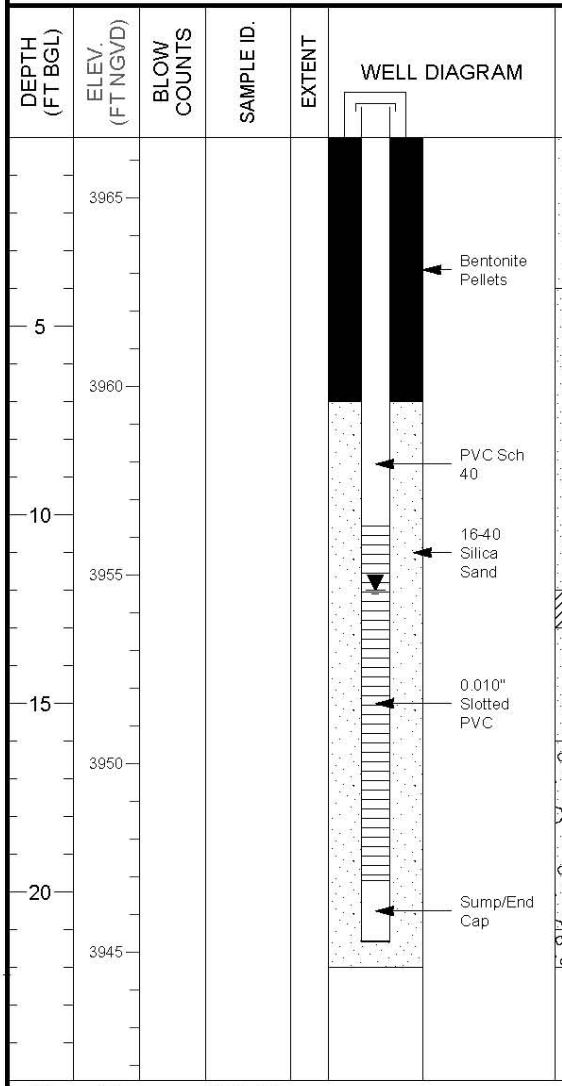
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0471

NORTH COORD. (FT) 6663361.48
EAST COORD. (FT) 2185991.55
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/25/2003
SURFACE ELEV. (FT NGVD) 3966.59
TOP OF CASING (FT) 3966.62
MEAS. PT. ELEV. (FT) 3966.62
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.03	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/25/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-4.0 ft. SANDY SILT (ML-SP); strong brown (7.5YR 4/6). 40% sand, fine grained, 60% silt/clay, moist.

4.0-12.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 25% silt, ~10% clay, 65% fine sand, moist.

12.0-13.0 ft. CLAY (CL); reddish gray (5YR 5/2), medium stiff, slightly mottled, moist.

13.0-16.0 ft. SAND (SP); reddish brown (5YR 5/2), fine to coarse grained with ~10% fine gravel, rounded, wet.

16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% gravel/cobbles fine to coarse, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.

21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.

Total Depth 22.0 ft.

MOA01-0472

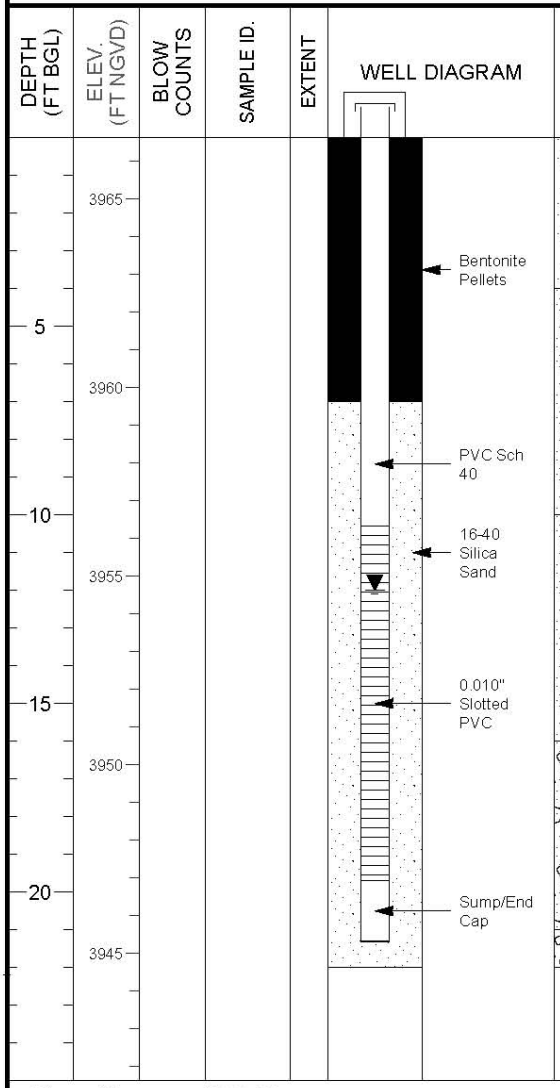
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0472

NORTH COORD. (FT) 6663386.00
EAST COORD. (FT) 2185995.11
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3966.62
TOP OF CASING (FT) 3966.68
MEAS. PT. ELEV. (FT) 3966.68
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.06	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/24/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-4.0 ft. SANDY SILT (ML-SP); reddish brown (5YR 4/4), 40% sand, fine grained, 60% silt/clay, moist.

4.0-10.0 ft. SILTY SAND (SM); dark reddish brown (5YR 3/4), 40% silt, ~50% fine sand, ~10 % clay (stiff), slightly mottled, moist.

10.0-16.0 ft. SAND (SP); reddish brown (5YR 4/4), fine to coarse grained with sand, ~10% fine gravel, subrounded to rounded, wet.

16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 10% silt/clay, 20% fine to coarse gravel/cobbles, subrounded to well rounded - cobbles are well rounded, 70% fine to coarse sand, wet.

21.0-22.0 ft. CLAYEY SILTY GRAVEL (GM); brown (7.5YR 4/3), 30% silt/clay, 20% fine to medium grained sand, 50% fine to coarse gravel, rounded to well rounded, trace of well rounded cobbles, wet.

Total Depth 22.0 ft.

MOA01-0473

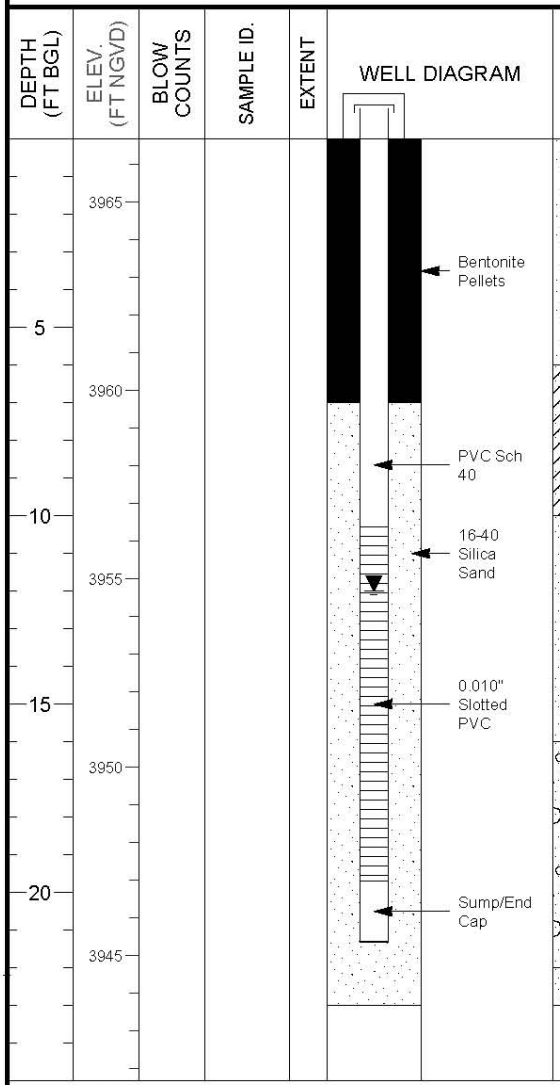
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0473

NORTH COORD. (FT) 6663411.34
EAST COORD. (FT) 2185999.02
HOLE DEPTH (FT) 23.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3966.67
TOP OF CASING (FT) 3966.74
MEAS. PT. ELEV. (FT) 3966.74
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.07	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	23.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/24/2003
LOGGED BY Pill, K.
REMARKS



0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.

6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.

10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.

16.0-22.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.

22.0-23.0 ft. CLAYEY GRAVELLY SAND (SP-SC); brown (7.5YR 4/4), 60% fine to medium sand, 20% silt/clay, 20% gravel subangular to subrounded, wet.

Total Depth 23.0 ft.

MOA01-0474

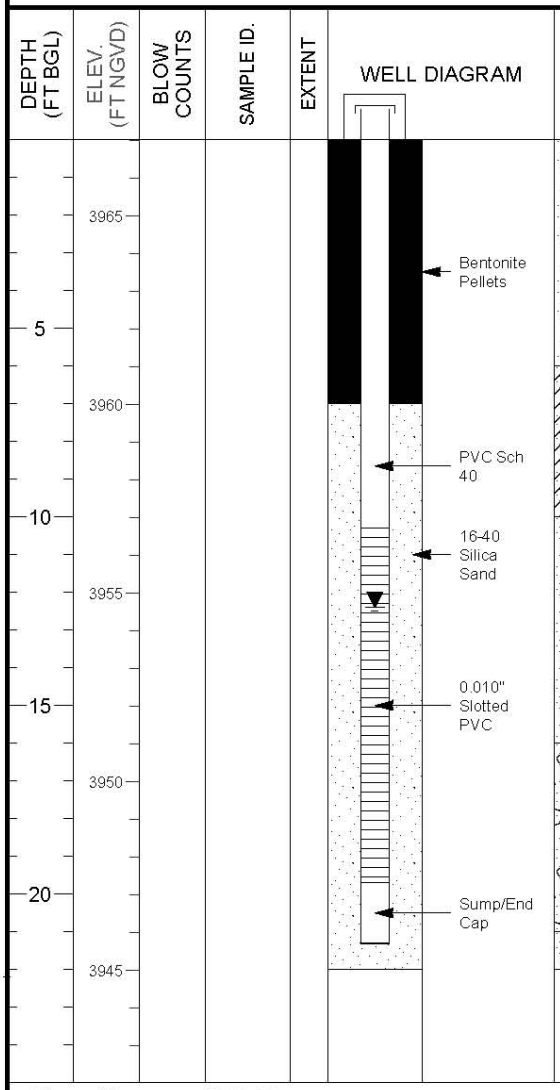
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0474

NORTH COORD. (FT) 6663435.71
EAST COORD. (FT) 2186002.61
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3967.02
TOP OF CASING (FT) 3967.10
MEAS. PT. ELEV. (FT) 3967.10
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.08	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.4 on 06/24/2003
LOGGED BY Pill, K.
REMARKS



MOA01-0475

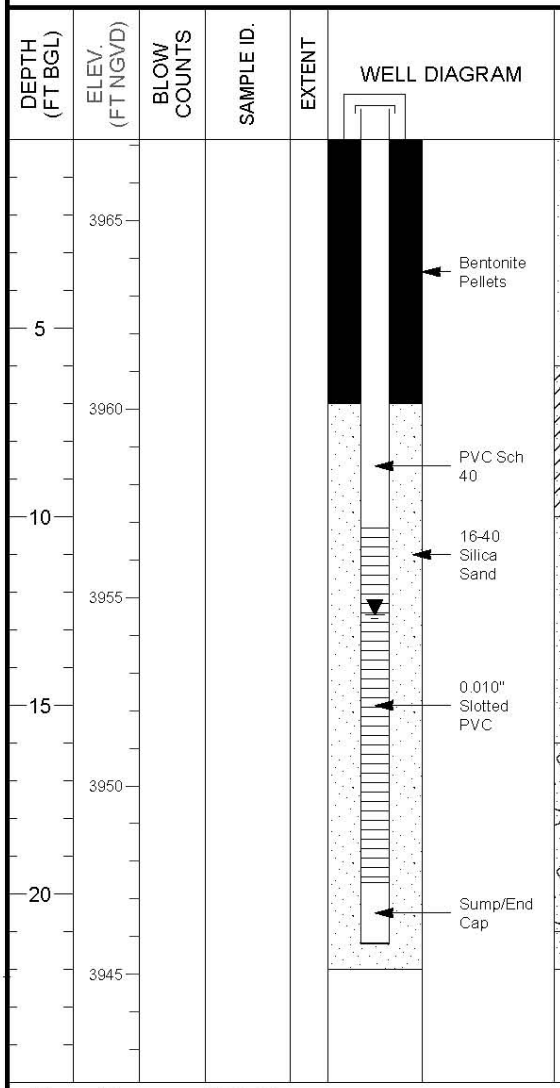
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0475

NORTH COORD. (FT) 6663460.70
EAST COORD. (FT) 2186005.78
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/24/2003
SURFACE ELEV. (FT NGVD) 3967.13
TOP OF CASING (FT) 3967.32
MEAS. PT. ELEV. (FT) 3967.32
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.19	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.6 on 06/24/2003
LOGGED BY Pill, K.
REMARKS



0-6.0 ft. SANDY SILT (ML-SP); dark yellowish brown (10YR 4/4), 30% fine sand, 70% silt/clay, moist.

6.0-10.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4), 20% clay (stiff), 10% fine sand, 70% silt, moist.

10.0-16.0 ft. SAND (SP); reddish brown (5YR 5/4), fine to coarse grained, clean, wet.

16.0-21.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4), 20% gravel, 80% fine to medium grained sand, trace of subangular cobbles, fine to coarse gravel, wet.

21.0-22.0 ft. CLAYEY GRAVELLY SAND (SP-SC); brown (7.5YR 4/4), 60% fine to medium sand, 20% silt/clay, 20% gravel subangular to subrounded, wet.

Total Depth 22.0 ft.

MOA01-0476

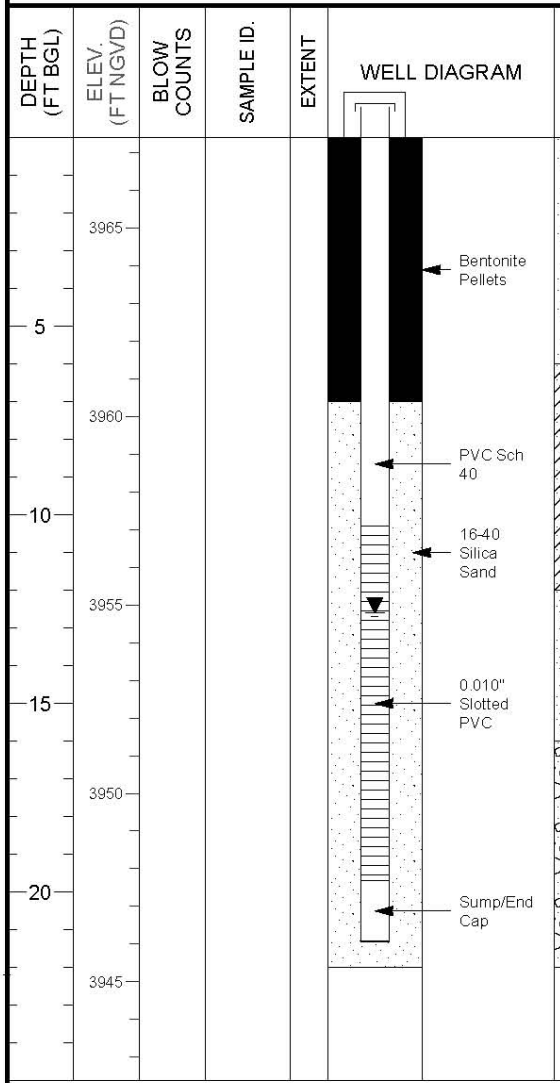
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0476

NORTH COORD. (FT) 6663485.25
EAST COORD. (FT) 2186009.58
HOLE DEPTH (FT) 22.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/23/2003
SURFACE ELEV. (FT NGVD) 3967.38
TOP OF CASING (FT) 3967.46
MEAS. PT. ELEV. (FT) 3967.46
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.08	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/24/2003
WATER LEVEL (FT BGS) 12.6 on 06/23/2003
LOGGED BY Pill, K.
REMARKS



MOA01-0477

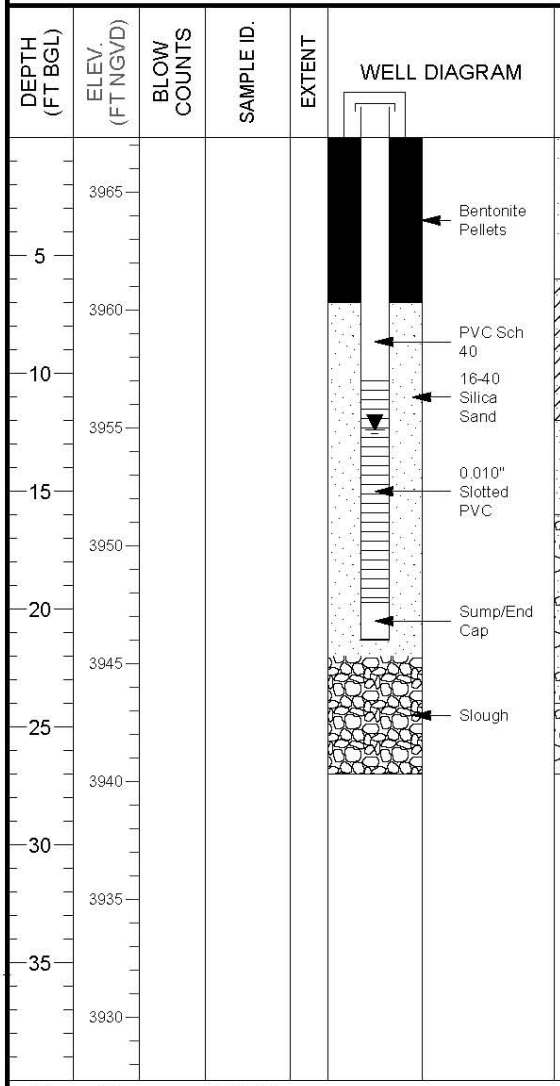
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0477

NORTH COORD. (FT) 6663510.11
EAST COORD. (FT) 2186012.49
HOLE DEPTH (FT) 27.00
WELL DEPTH (FT) 21.30

DATE DRILLED 06/23/2003
SURFACE ELEV. (FT NGVD) 3967.30
TOP OF CASING (FT) 3967.30
MEAS. PT. ELEV. (FT) 3967.30
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	0.0	to	10.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	10.3	to	19.7
SUMP/END CAP:	4 in. PVC Sch 40	19.7	to	21.3
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 12.4 on 06/23/2003
LOGGED BY Pill, K.
REMARKS



MOA01-0478

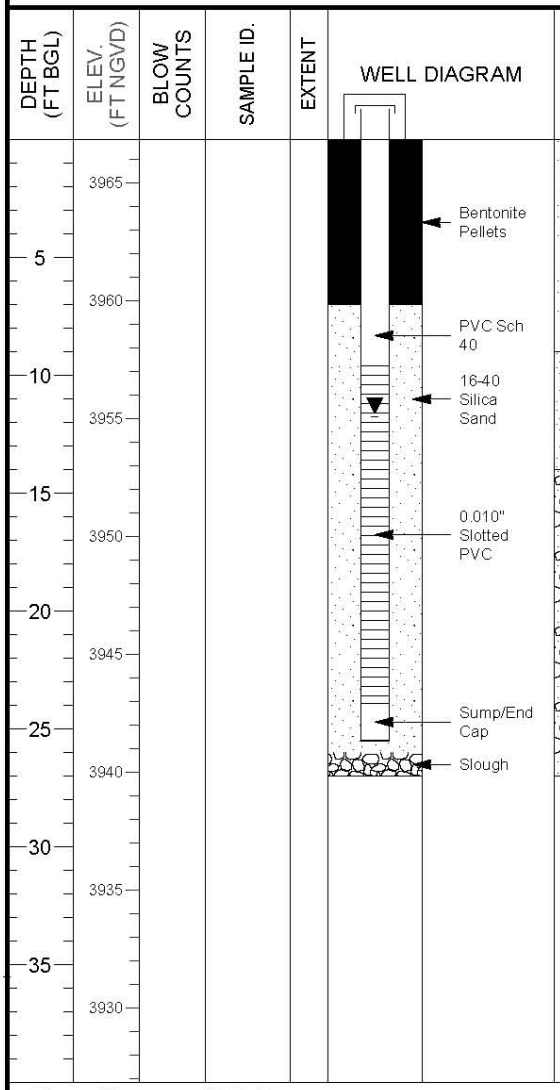
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0478

NORTH COORD. (FT) 6663535.08
EAST COORD. (FT) 2186015.76
HOLE DEPTH (FT) 27.00
WELL DEPTH (FT) 25.50

DATE DRILLED 06/21/2003 to 06/23/2003
SURFACE ELEV. (FT NGVD) 3966.82
TOP OF CASING (FT) 3967.43
MEAS. PT. ELEV. (FT) 3967.43
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.61	to	9.6
WELL SCREEN:	4 in. 0.01 Slotted PVC	9.6	to	23.9
SUMP/END CAP:	4 in. PVC Sch 40	23.9	to	25.5
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	26.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 11.6 on 06/21/2003
LOGGED BY Pill, K.
REMARKS



MOA01-0479

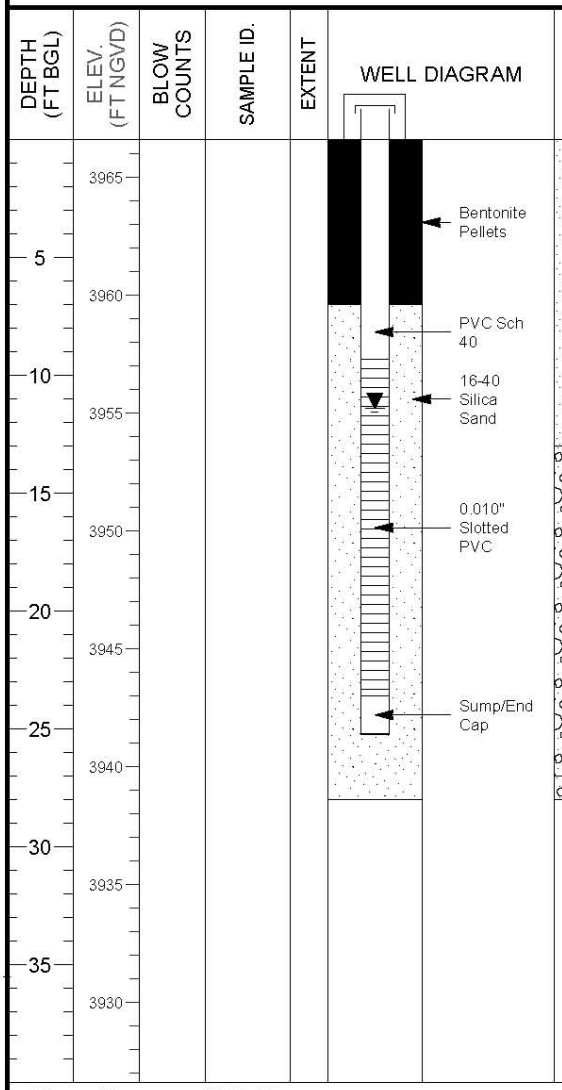
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0479

NORTH COORD. (FT) 6663559.47
EAST COORD. (FT) 2186019.45
HOLE DEPTH (FT) 28.00
WELL DEPTH (FT) 25.20

DATE DRILLED 06/21/2003
SURFACE ELEV. (FT NGVD) 3966.60
TOP OF CASING (FT) 3967.13
MEAS. PT. ELEV. (FT) 3967.13
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-0.53	to	9.3
WELL SCREEN:	4 in. 0.01 Slotted PVC	9.3	to	23.6
SUMP/END CAP:	4 in. PVC Sch 40	23.6	to	25.2
SURFACE SEAL:				
GROUT:				
SEAL:	Bentonite Pellets	0.0	to	7.0
UPPER PACK:				
LOWER PACK:	16-40 Silica Sand	7.0	to	26.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/23/2003
WATER LEVEL (FT BGS) 11.4 on 06/21/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-13.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), 80% fine to medium grained sand, 20% silt/clay, moist.

9.0-13.0 ft. color changes to reddish brown (5YR 4/4), sand is more coarse, and less silt/clay (10%).

13.0-27.0 ft. SANDY GRAVEL (GP-SP); dark reddish brown (5YR 3/4), medium to coarse grained sand, subrounded to rounded gravel, trace of silt and cobbles, wet.

27.0-28.0 ft. GRAVELLY SAND (SP-GP); dark red brown (5YR 3/4), slightly finer grained sand. No clay.

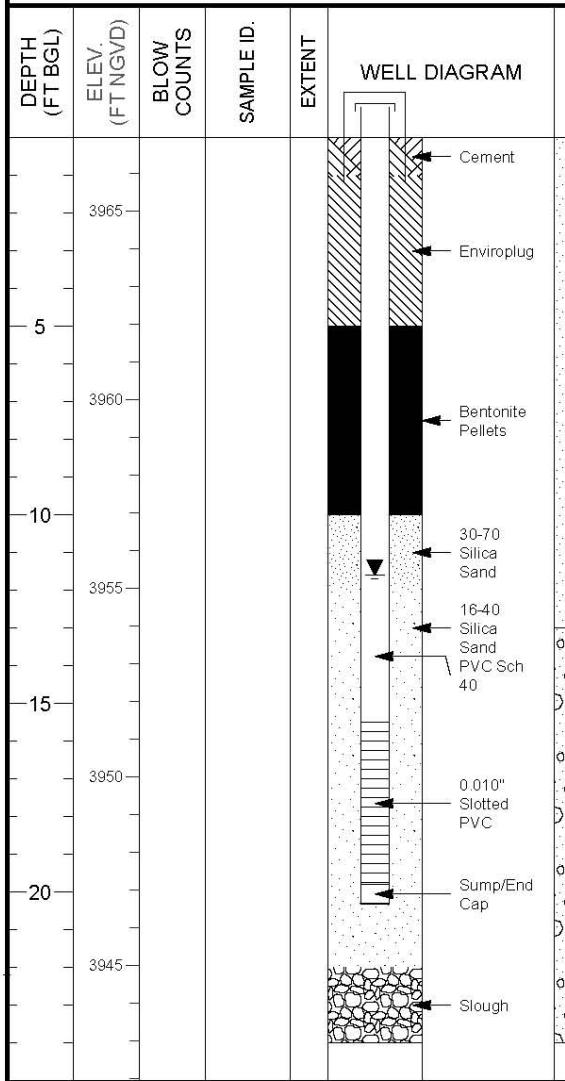
Total Depth 28.0 ft.

MOA01-0480

PROJECT	MOAB	**NORTH COORD. (FT)**	6663451.03	**DATE DRILLED**	06/21/2003
LOCATION	Moab, UT	**EAST COORD. (FT)**	2185984.93	**SURFACE ELEV. (FT NGVD)**	3966.94
SITE	MOAB	**HOLE DEPTH (FT)**	24.00	**TOP OF CASING (FT)**	3968.65
WELL NUMBER	0480	**WELL DEPTH (FT)**	20.30	**MEAS. PT. ELEV. (FT)**	3968.65
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	9.0 / / 6.0

WELL INSTALLATION		**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.71	to	15.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	15.5	to	19.8
SUMP/END CAP:	4 in. PVC Sch 40	19.8	to	20.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	12.0
LOWER PACK:	16-40 Silica Sand	12.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 11.6 on 06/21/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.

13.0-24 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet

@16.0 ft. sand becomes coarse.

Total Depth 24.0 ft.

MOA01-0481

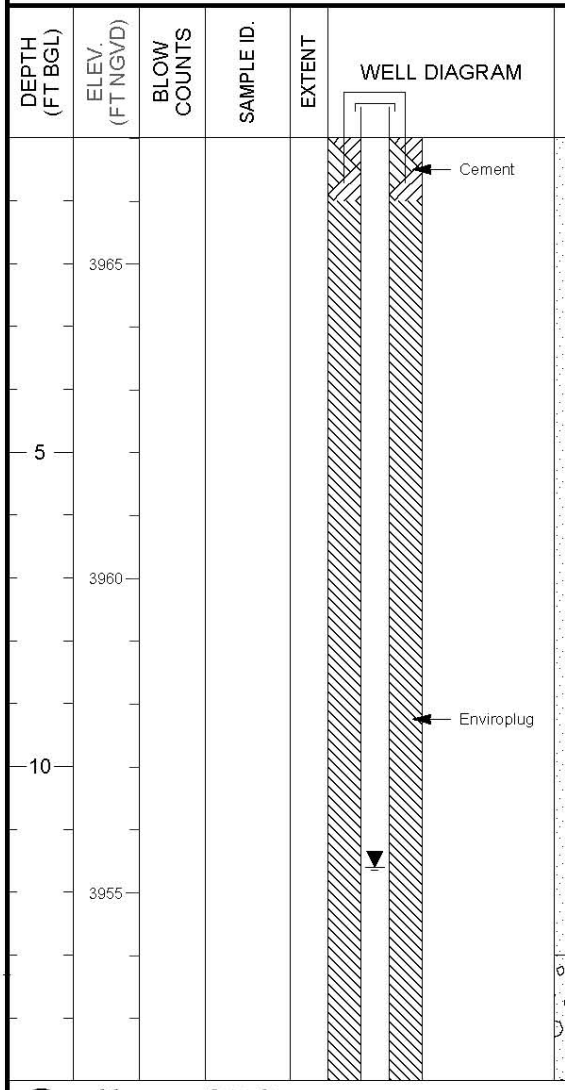
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0481

NORTH COORD. (FT) 6663447.46
EAST COORD. (FT) 2185978.30
HOLE DEPTH (FT) 33.40
WELL DEPTH (FT) 31.30

DATE DRILLED 06/20/2003
SURFACE ELEV. (FT NGVD) 3967.01
TOP OF CASING (FT) 3968.83
MEAS. PT. ELEV. (FT) 3968.83
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.82	to	25.4
WELL SCREEN:	4 in. 0.01 Slotted PVC	25.4	to	29.7
SUMP/END CAP:	4 in. PVC Sch 40	29.7	to	31.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	17.5
SEAL:	Bentonite Pellets	17.5	to	18.0
UPPER PACK:	30-70 Silica Sand	18.0	to	22.0
LOWER PACK:	16-40 Silica Sand	22.0	to	31.3

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 11.6 on 06/20/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

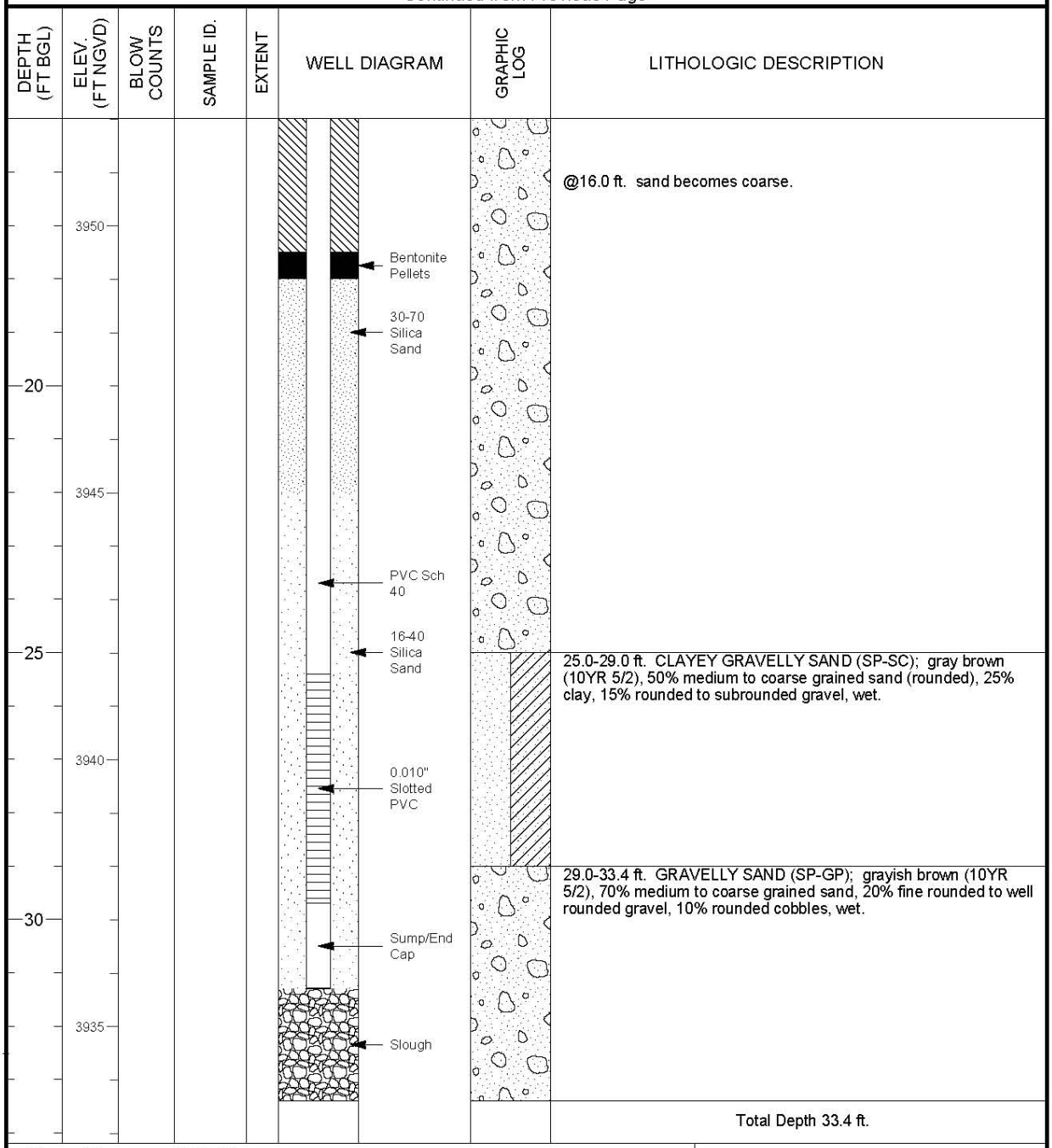
0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.

13.0-25 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet

MOA01-0481

PROJECT MOAB **WELL NUMBER** 0481
SITE MOAB **DATES DRILLED** 06/20/2003

Continued from Previous Page

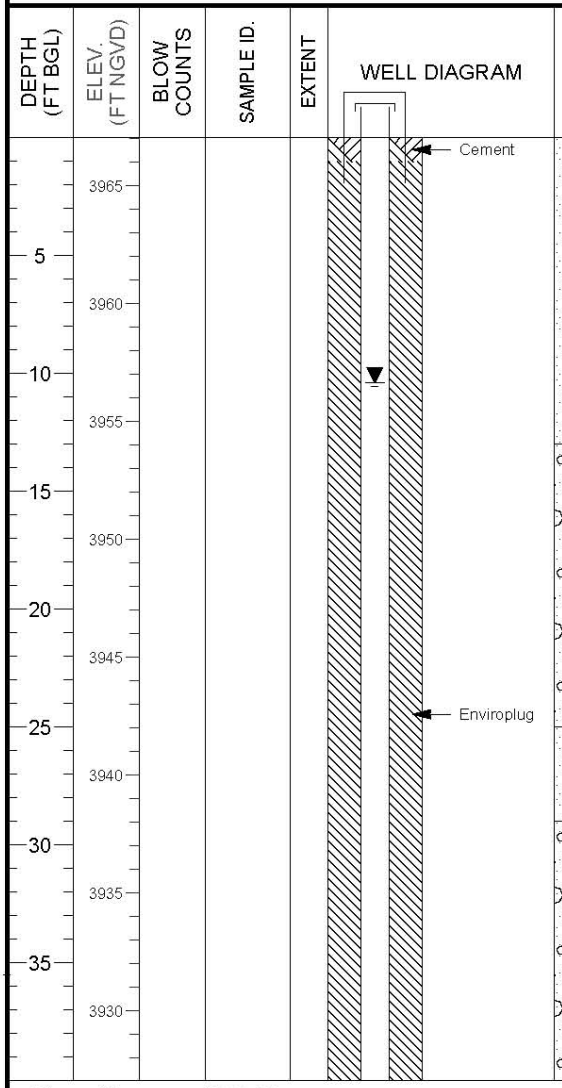


MOA01-0482

PROJECT	MOAB	**NORTH COORD. (FT)**	6663455.70	**DATE DRILLED**	06/19/2003
LOCATION	Moab, UT	**EAST COORD. (FT)**	2185978.84	**SURFACE ELEV. (FT NGVD)**	3967.03
SITE	MOAB	**HOLE DEPTH (FT)**	64.00	**TOP OF CASING (FT)**	3968.70
WELL NUMBER	0482	**WELL DEPTH (FT)**	61.30	**MEAS. PT. ELEV. (FT)**	3968.70
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	9.0 / / 6.0

WELL INSTALLATION		**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.67	to	55.4
WELL SCREEN:	4 in. 0.01 Slotted PVC	55.4	to	59.7
SUMP/END CAP:	4 in. PVC Sch 40	59.7	to	61.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	47.9
SEAL:	Bentonite Pellets	47.9	to	48.0
UPPER PACK:	30-70 Silica Sand	48.0	to	52.0
LOWER PACK:	16-40 Silica Sand	52.0	to	64.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/25/2003
WATER LEVEL (FT BGS) 10.4 on 06/20/2003
LOGGED BY Pill, K.
REMARKS



0-13.0 ft. SILTY SAND (SM); reddish brown (5YR 4/4), 50% fine to very fine sand, 50% silt/clay, moist.

13.0-25 ft. GRAVELLY SAND (SP-GP); reddish brown (5YR 4/4), 75% fine to medium grained sand (rounded), 20% rounded to subrounded gravel (1/2" to 1.0" in diameter), trace of silt/clay, wet

@16.0 ft. sand becomes coarse.

25.0-29.0 ft. CLAYEY GRAVELLY SAND (SP-SC); gray brown (10YR 5/2), 50% medium to coarse grained sand (rounded), 25% clay, 15% rounded to subrounded gravel, wet.

29.0-64.0 ft. GRAVELLY SAND (SP-GP); grayish brown (10YR 5/2), 70% medium to coarse grained sand, 20% fine rounded to well rounded gravel, 10% rounded cobbles, wet.

MOA01-0482

PROJECT MOAB **WELL NUMBER** 0482
SITE MOAB **DATES DRILLED** 06/19/2003

Continued from Previous Page

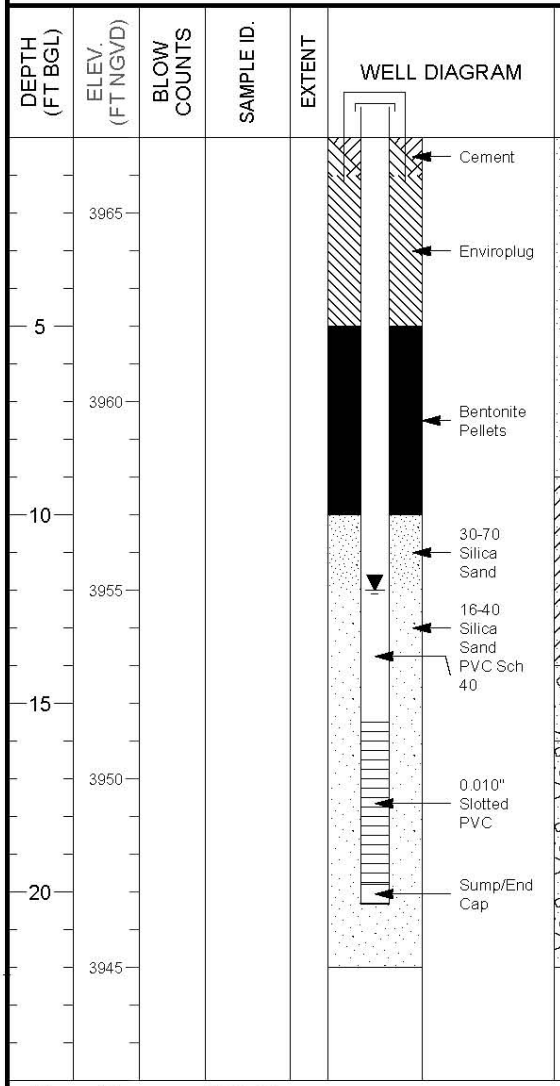
DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE ID.	EXTENT	WELL DIAGRAM	GRAPHIC LOG	LITHOLOGIC DESCRIPTION
45	3925						@ 40.0 ft. slightly coarser grains, fine crystalline lithic types (up to 6.0" to 8.0" in diameter).
50	3920				Bentonite Pellets 30-70 Silica Sand		
55	3915				16-40 Silica Sand PVC Sch 40		
60	3910				0.010" Slotted PVC		
65	3905				Sump/End Cap		Total Depth 64.0 ft.
70	3900						
75	3895						
80	3890						
85	3885						
90	3880						

MOA01-0483

PROJECT	MOAB	**NORTH COORD. (FT)**	6663447.82	**DATE DRILLED**	06/23/2003
LOCATION	Moab, UT	**EAST COORD. (FT)**	2186014.93	**SURFACE ELEV. (FT NGVD)**	3967.00
SITE	MOAB	**HOLE DEPTH (FT)**	22.00	**TOP OF CASING (FT)**	3968.90
WELL NUMBER	0483	**WELL DEPTH (FT)**	20.30	**MEAS. PT. ELEV. (FT)**	3968.90
				SLOT SIZE (IN)	0.010
				BIT SIZE(S) (IN)	9.0 / / 6.0

WELL INSTALLATION		**INTERVAL (FT)**		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.9	to	15.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	15.5	to	19.8
SUMP/END CAP:	4 in. PVC Sch 40	19.8	to	20.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	5.0
SEAL:	Bentonite Pellets	5.0	to	10.0
UPPER PACK:	30-70 Silica Sand	10.0	to	12.0
LOWER PACK:	16-40 Silica Sand	12.0	to	22.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.0 on 06/23/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-9.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), fine grained sand, 40% silt/clay, moist.

9.0-14.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4); 20% fine grained sand, 60% silt, 20% clay, stiff, slightly mottled, moist.

14.0-16.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4); fine to coarse grained sand, fine gravel, subrounded to rounded, 10% silt, moist.

16.0-22.0 ft. SANDY GRAVEL (GP-SP); brown (7.5YR 4/4), medium to coarse grained sand, subangular to subrounded gravel, cobbles, wet.

Total Depth 22.0 ft.

MOA01-0484

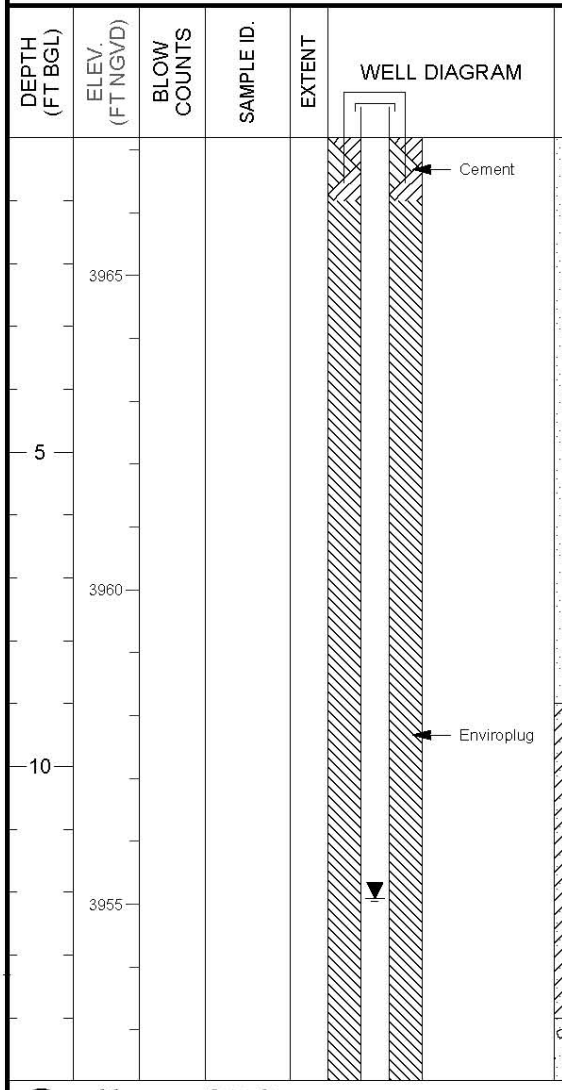
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0484

NORTH COORD. (FT) 6663457.71
EAST COORD. (FT) 2186019.38
HOLE DEPTH (FT) 32.00
WELL DEPTH (FT) 30.30

DATE DRILLED 06/22/2003
SURFACE ELEV. (FT NGVD) 3967.19
TOP OF CASING (FT) 3969.19
MEAS. PT. ELEV. (FT) 3969.19
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-2.0	to	25.5
WELL SCREEN:	4 in. 0.01 Slotted PVC	25.5	to	29.8
SUMP/END CAP:	4 in. PVC Sch 40	29.8	to	30.3
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	1.0	to	18.0
SEAL:	Bentonite Pellets	18.0	to	18.5
UPPER PACK:	30-70 Silica Sand	18.5	to	22.0
LOWER PACK:	16-40 Silica Sand	22.0	to	32.0

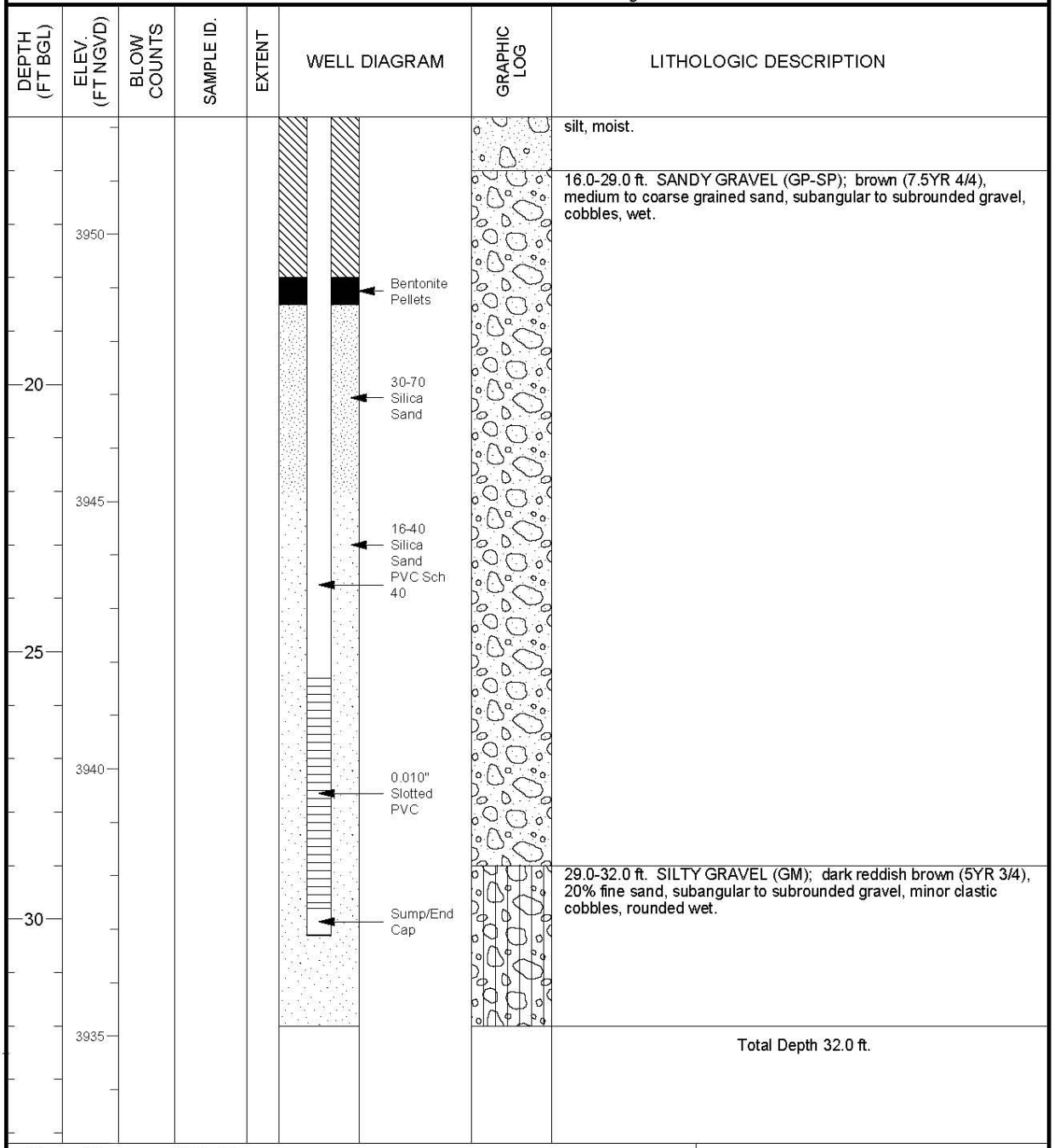
DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 12.1 on 06/23/2003
LOGGED BY Pill, K.
REMARKS



MOA01-0484

PROJECT MOAB **WELL NUMBER** 0484
SITE MOAB **DATES DRILLED** 06/22/2003

Continued from Previous Page



MOA01-0485

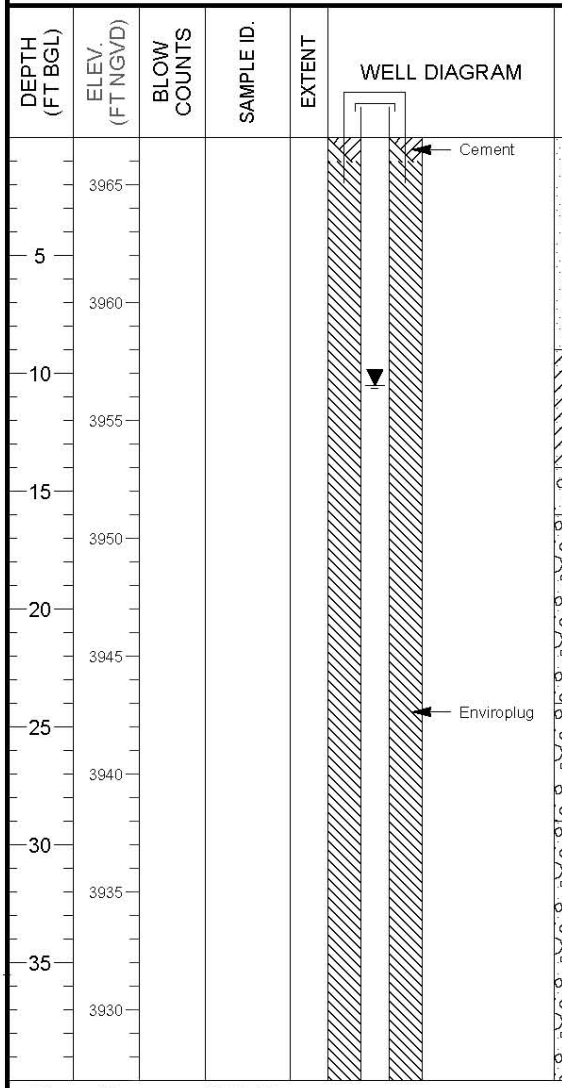
PROJECT MOAB
LOCATION Moab, UT
SITE MOAB
WELL NUMBER 0485

NORTH COORD. (FT) 6663446.91
EAST COORD. (FT) 2186022.10
HOLE DEPTH (FT) 63.00
WELL DEPTH (FT) 60.40

DATE DRILLED 06/22/2003
SURFACE ELEV. (FT NGVD) 3966.99
TOP OF CASING (FT) 3968.81
MEAS. PT. ELEV. (FT) 3968.81
SLOT SIZE (IN) 0.010
BIT SIZE(S) (IN) 9.0 / / 6.0

WELL INSTALLATION		INTERVAL (FT)		
SURFACE CASING:				
BLANK CASING:	4 in. PVC Sch 40	-1.82	to	55.6
WELL SCREEN:	4 in. 0.01 Slotted PVC	55.6	to	59.9
SUMP/END CAP:	4 in. PVC Sch 40	59.9	to	60.4
SURFACE SEAL:	Cement	0.0	to	1.0
GROUT:	Enviroplug	0.0	to	47.7
SEAL:				
UPPER PACK:	30-70 Silica Sand	47.7	to	52.0
LOWER PACK:	16-40 Silica Sand	52.0	to	63.0

DRILLING METHOD AIR HAMMER PERCUSSION
SAMPLING METHOD CYCLONE
DATE DEVELOPED 06/26/2003
WATER LEVEL (FT BGS) 10.5 on 06/22/2003
LOGGED BY Pill, K.
REMARKS



LITHOLOGIC DESCRIPTION

0-9.0 ft. SILTY SAND (SM); brown (7.5YR 4/4), fine grained sand, 40% silt/clay, moist.

9.0-14.0 ft. CLAYEY SILT (SC-SM); brown (7.5YR 4/4); 20% fine grained sand, 60% silt, 20% clay, stiff, slightly mottled, moist.

14.0-16.0 ft. GRAVELLY SAND (SP-GP); brown (7.5YR 4/4); fine to coarse grained sand, fine gravel, subrounded to rounded, 10% silt, moist.
@15.0 ft. pine cone wood fragments at 15.0 ft.

16.0-24.0 ft. SANDY GRAVEL (GP-SP); brown (7.5YR 4/4), medium to coarse grained sand, subangular to subrounded gravel, cobbles, wet.

24.0-29.0 ft. SILTY GRAVEL (GM); yellowish red (5YR 4/6), 25% fine to medium grained sand, 30% silt/clay, subrounded to rounded gravel and cobbles, clastic, wet.

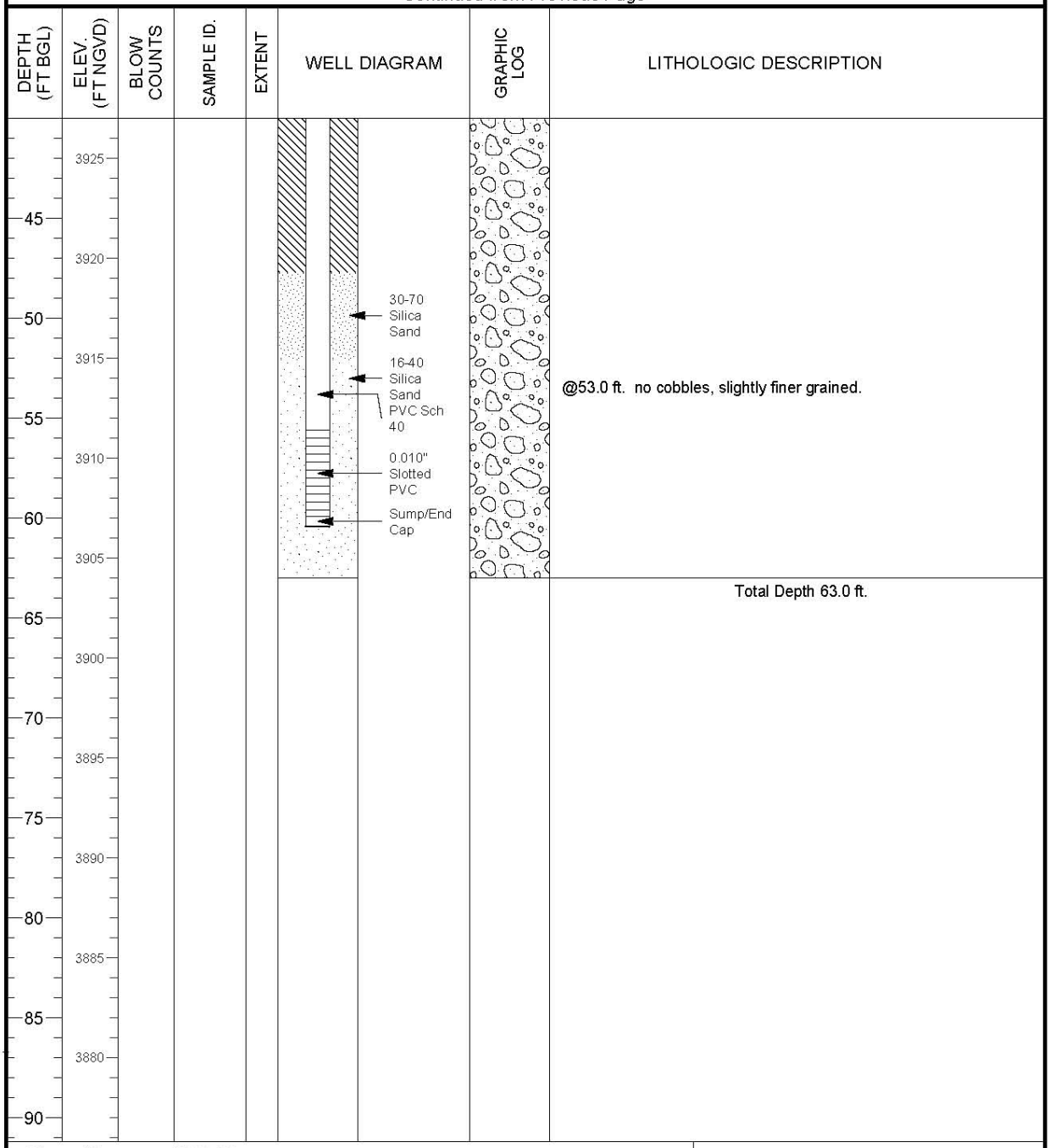
29.0-63.0 ft. SANDY GRAVEL (GP-SP); reddish brown (5YR 4/4), medium to coarse grained sand, fine to coarse gravel, 20% subrounded to rounded cobbles, clastic, wet.

36.0-63.0 ft. color changes to dark gray (10YR 4/1), 30% medium to coarse grained sand, fine to coarse and subangular to rounded gravel 10% clastic cobbles (up to 8.0" in diameter), well rounded, wet.

MOA01-0485

PROJECT MOAB **WELL NUMBER** 0485
SITE MOAB **DATES DRILLED** 06/22/2003

Continued from Previous Page



Appendix B

Well Development Records

MOAB WELL DEVELOPMENT RECORD

Moab Well No 470

Date 6/26/03 **Static DTW** 12.33 **Well TD** 20'

Pump Used Trash **Field Rep** SP S.L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1226	1253	Pump @ 16 gpm			
1255	1300	Surge			
1301	1309	Pump @ 16 gpm			
1310	1314	Surge			
1315	1322	Pump @ 16 gpm			
1323	1326	Surge			
1327	1333	Pump @ 16 gpm			
1334	1338	Surge			
1339	1352	Pump @ 16 gpm Turbidity = 3.21			

2.73 DTW 07-01-03

MOAB WELL DEVELOPMENT RECORD

Moab Well No 471

Date 6/26/03 **Static DTW** 12.29 **Well TD** 20'

Pump Used Trash **Field Rep** JP S. L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1117	1122	Pump @ 16 gpm			
1124	1130	Surge			
1131	1139	Pump @ 16 gpm			
1140	1144	Surge			
1144	1151	Pump @ 16 gpm			
1151	1155	Surge			
1155	1200	Pump @ 16 gpm			
1201	1206	Surge			
1206	1221	Pump @ 16 gpm Turbidity		4.47	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 472

Date 6/26/03 **Static DTW** 12.30' **Well TD** 20'

Pump Used Trash **Field Rep** DP S.L. = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0930	0936	Pump @ 16 gpm			
0937	0945	Surge			
0947	0954	Pump @ 16 gpm			
0955	0959	Surge			
1000	1005	Pump @ 16 gpm			
1006	1010	Surge			
1011	1016	Pump @ 16 gpm			
1018	1022	Surge			
1023	1035	Pump @ 16 gpm Turbidity 7.31			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 473

Date 6/26/03 Static DTW 12.25' Well TD 20'

Pump Used Trash Field Rep SP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0800	0815	Pump @ 15 gpm			
0816	0826	Surge			
0827	0836	Pump @ 16 gpm			
0837	0841	Surge			
0842	0849	Pump @ 16 gpm			
0850	0854	Surge			
0856	0902	Pump @ 16 gpm			
0903	0907	Surge			
0909	0920	Pump @ 16 gpm Turbidity 5.12'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 474

Date 6/24/03 Static DTW 12.58' Well TD 20'

Pump Used Trash Field Rep JP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1810	1823	Pump @ ≈ 18 gpm			
1824	1830	Surge			
1830	1840	Pump @ 18 gpm			
0750	0755	Surge			
0757	0818	Pump @ 18 gpm			
0819	0825	Surge			
~~0838~~		P			
0826	0838	Pump @ 18 gpm			
0839	0846	Surge			
0847	0726	Pump @ 18 gpm			
		WL = 16.27' Turbidity = 3.27			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 475

Date 6/24/03 **Static DTW** 12.77 **Well TD** 20'

Pump Used Trash **Field Rep** JP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1600	1620	Pump @ 18 gpm			
1630	1638	Surge			
1639	1651	Pump @ 18 gpm			
1652	1658	Surge			
1659	1715	Pump @ 18 gpm			
1716	1722	Surge			
1722	1738	Pump @ 18 gpm WL ≈ 15½' ??			
1738	1745	Surge			
1745	1808	Pump @ 18 gpm Turbidity	6.35	WL = 15½'	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 476

Date 6/24/03 **Static DTW** 12.61 **Well TD** 20'

Pump Used Trash **Field Rep** IP SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0938	10:00	Pump @ 9 1/2 gpm WL = 14.05			
10:05	10:15	Surge w/ Swab			
1017	10:38	Pump @ ≈ 18 gpm			
10:39	1045	Surge.			
1047	1103	Pump @ ≈ 18 gpm			
1104	1115	Surge			
1116	1151	Pump @ ≈ 18 gpm WL = 15.05' Turbidity = 9.92			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 477

Date 6/23/03 Static DTW ≈ 12' Well TD 20'

Pump Used Trash Field Rep JP

SL = 10'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1640	1655	Pump ≈ 19 gpm			
1700	1706	Surge w/ Swivel Rig.			
1707	1715	Pump @ ≈ 20 gpm - Drawdown to pump intake			
1716	1723	Surge			
1723	1745	Pump @ ≈ 17 gpm WL @ 16.9'			
1746	1757	Surge			
1757	1815	Pump @ ≈ 17 gpm WL @ 16.5'			
1815	1830	Pump @ ≈ 3 gpm			
		SPEC COND = 28150 AT ~17 GPM			
		REDUCED FLOW TO ~3 GPM, SL = 27.40			
		WL = 12.95 FOR ~ 20 MIN			
1830	1835	Surge			
1835	1849	Pump @ ≈ 17 gpm WL = 15.15'			
0734	0740	Surge WL = 12.41'			
0740	0830	Pump @ 17 gpm			
0836	0843	Surge			
0845	0904	Pump @ 17 gpm Turbidity = 9.21	WL = 15.4'		

MOAB WELL DEVELOPMENT RECORD

Moab Well No 478

Date 6/23/03 Static DTW 12.3 Well TD 25'

Pump Used Trash Field Rep JP/ICP SL = 15'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
		INIT PUMPING AT ~3 GPM, AFTER ~5 MIN, WL = 12.7, ~0.4' s			
		AT ~4 GPM WL = 13.0 (AFTER ONLY 2 MIN)			
		AT ~9 GPM WL = 14.0 (AFTER ONLY ~2 MIN)			
1342	1347	Surge			
1348	1405	Pump @ ≈ 18 gpm WL ≈ 19.8'			
1405	1413	Surge			
1414	1428	Pump @ ≈ 18 gpm No reliable WL			
1429	1435	Surge			
1437	1452	Pump @ ≈ 18 gpm			
1453	1500	Surge			
1501	1525	Pump @ ≈ 18 gpm No reliable WL ≈ 19' Turbidity = 27.9			
1530	1535	Surge			
1535	1550	Pump @ 18 gpm TURB = 98.0			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 479

Date 4/23/03 **Static DTW** 12.0' **Well TD** 25'

Pump Used Trash **Field Rep** SL SL = 15'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
		INITIAL PUMPING AT ≈ 3 GPM, ~~DRAWDOWN~~ WL = 12.4'			
		AFTER 5 MIN OF PUMPING, ONLY ≈ 0.4 S			
1200	1216	Surge w/ Smack			
1217	1238	Pump @ ≈ 18 gpm w/ 4' of drawdown Final drawdown of ≈ 5' Pump until clear water			
1240	1248	Surge			
1250	1326	Pump ≈ 20 gpm V. turbid - Drawdown to 17' Turbidity = 14.5			
1326	1336	Surge			
1336	1402	Pump ≈ 20 gpm Drawdown to 17.3' Turbid = 7.50			
1403	1413	Surge			
1415	1430	Pump ≈ 20 gpm			
1522	1529	Surge			
1530	1535	Pump ≈ 20 gpm			
1535	1543	Surge			
1543	1620	Pump ≈ 20 gpm Turbidity = 4.71 WL = 17.7'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 480

Date 6/25/03 Static DTW 14.14 Well TD 22.4' BTOC

Pump Used Trash Field Rep JP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
0942	0954	Pump @ 18 gpm			
0955	1004	Surge w/ Smeal Rig			
1005	1012	Pump @ 18 gpm			
1013	1018	Surge			
1019	1027	Pump @ 18 gpm			
1028	1033	Surge			
1033	1107	Pump @ 18 gpm WL = 17.58'			
		Turbidity = 12.5			
1310		Finish development w/ small Grundfos pump		Q =	1/2 gpm
~~1310~~		Conductivity / Turbidity			
1312		27670 / 6.20			
1351		26560 / 1.28			
~~1408~~	1414	25340 / 1.25			
1426		26330 / 1.81			
1438		25110 / 0.98			
1448		24760 / 1.13 STOP Pumping 1450			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 481

Date 6/25/03 Static DTW 14.02 Well TD ~~481~~ 33.4' BTOC

Pump Used Trash Field Rep JP S.L. = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
~~11:45~~					
12:47	1257	Pump @ 20 gpm			
1324	1331	Surge w/ Smeal			
1332	1346	Pump @ 18-20 gpm			
1350	1358	Surge			
1359	1418	Pump @ 18-20 gpm			
1419	1425	Surge			
1426	1446	Pump @ 18-20 gpm WL = 19.28			
		Turbidity = 64.0			
				1.0	
1505		Purge w/ small Grundfos pump @ ~~½~~ gpm			
~~1530~~		Conductivity / Turbidity			
1530		35610 / 8.73			
1544		35140 / 11.3			
1555		35340 / 12.1			
1606		35080 / 13.7			
1624		34690 / 13.7 Turned pump off 1625			
	1730				
1650	~~1745~~	Pump w/ trash pump @ 18-20 gpm.			
1730	1740	Surge			
1741	1805	Pump 18 gpm			
1810	1825	Surge			
1815	1825	Pump 18 gpm			
0710	0800	Pump 18 gpm - Slow rate to 10 gpm			
		Turbidity = 6.15			

6

MOAB WELL DEVELOPMENT RECORD

Moab Well No 482

Date 6/26/03 **Static DTW** 13.33 **Well TD** 63.4

Pump Used Trash **Field Rep** CP S.L. = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1454	1509	Pump @ 15-18 gpm			
1510	1520	Surge			
1521	1545	Pump @ 15-18 gpm			
1547	1557	Surge			
1559	1614	Pump @ 15-16 gpm			
		Turbidity = 3.44 WL =	22.40	1	

MOAB WELL DEVELOPMENT RECORD

Moab Well No 483

Date 6/26/07 **Static DTW** 14.46 **Well TD** 22.4'

Pump Used Trash **Field Rep** JP SC = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1407	1418	Pump @ 16-17 gpm			
1419	1424	Surge			
1425	1431	Pump @ 16 gpm			
1432	1435	Surge			
1436	1443	Pump @ 16 gpm			
1443	1447	Surge			
1448	1455	Pump @ 16 gpm			
1455	1500	Surge			
1500	1508	Pump @ 16 gpm			
1508	1520	Pump @ 5 gpm Turbidity = 5.57			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 484

Date 6/26/03 **Static DTW** 14.50 **Well TD** 32.4

Pump Used Trash **Field Rep** DP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1522	1529	Pump - Well meter only 5 gpm			
1530	1535	Surge			
1540	1625	Pump - w/ Grundfos @ 2½ gpm			
		Will need more development			
1/1/03 0840		WL = 15.20'			

MOAB WELL DEVELOPMENT RECORD

Moab Well No 485

Date 6/26/03 **Static DTW** 13.07 **Well TD** 62.4

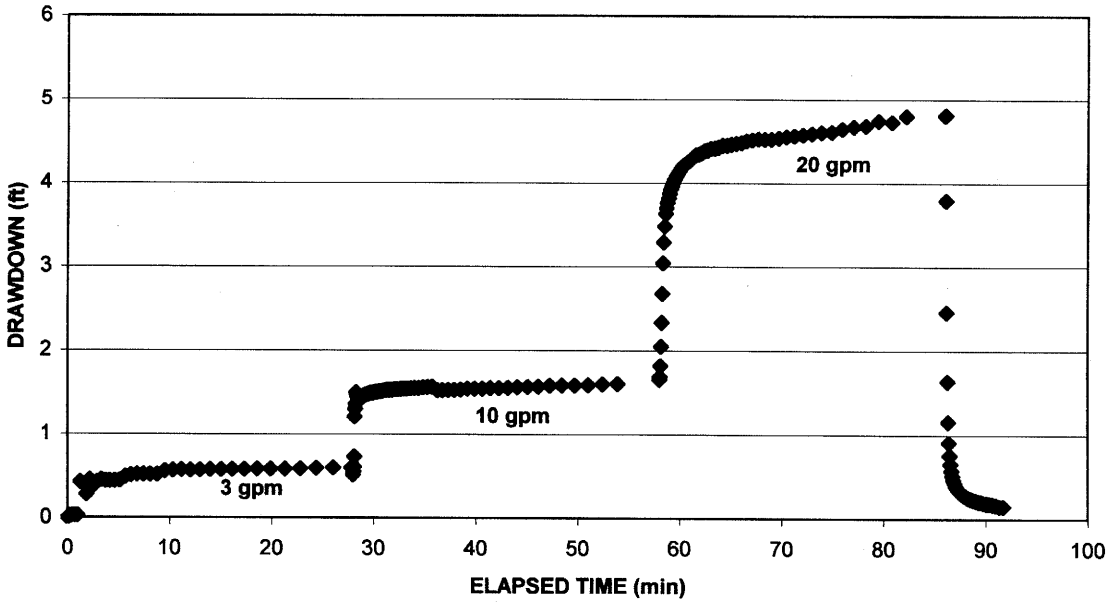
Pump Used Trash **Field Rep** SP SL = 5'

Start Time	Finish Time	Development Activity	Gallons Removed	Total	Turbidity
1547	1558	Pump @ 20 gpm			
1559	1603	Surge			
1603	1622	Pump @ 20 gpm ~~Tub~~ Turbidity =			7.09

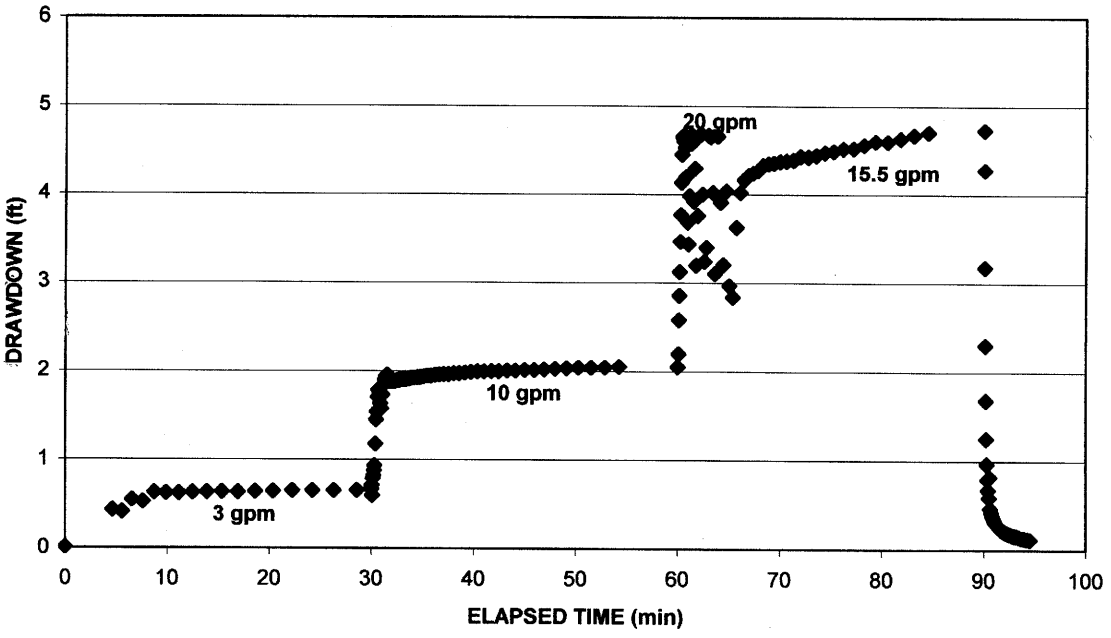
Appendix C

Step-Test Plots

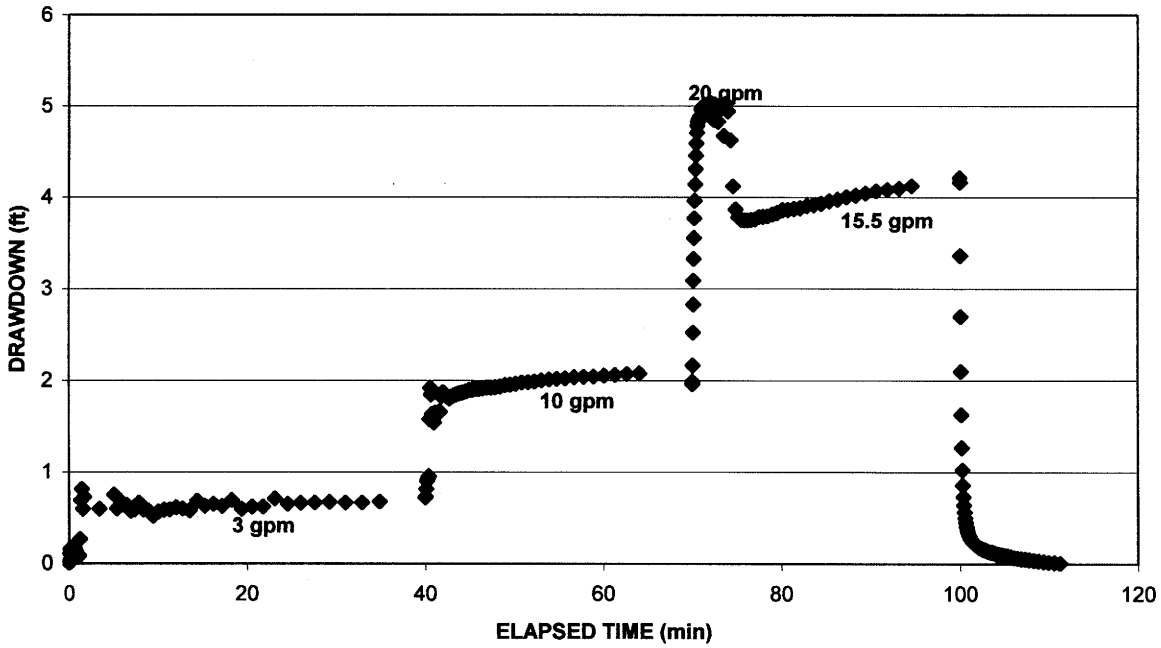
WELL 470



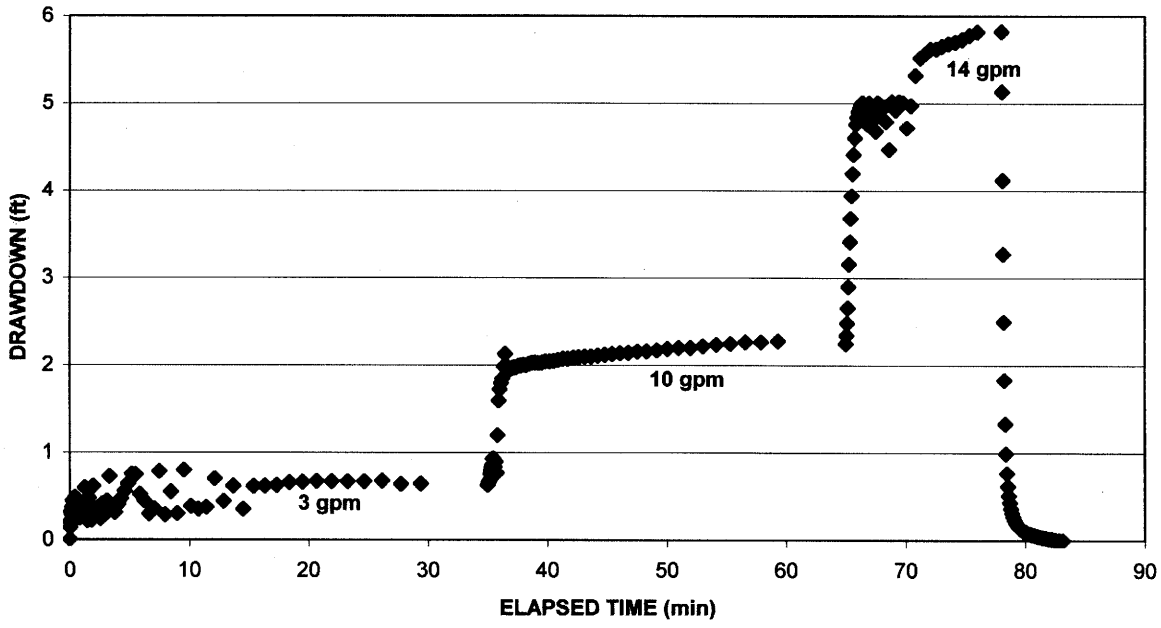
WELL 471



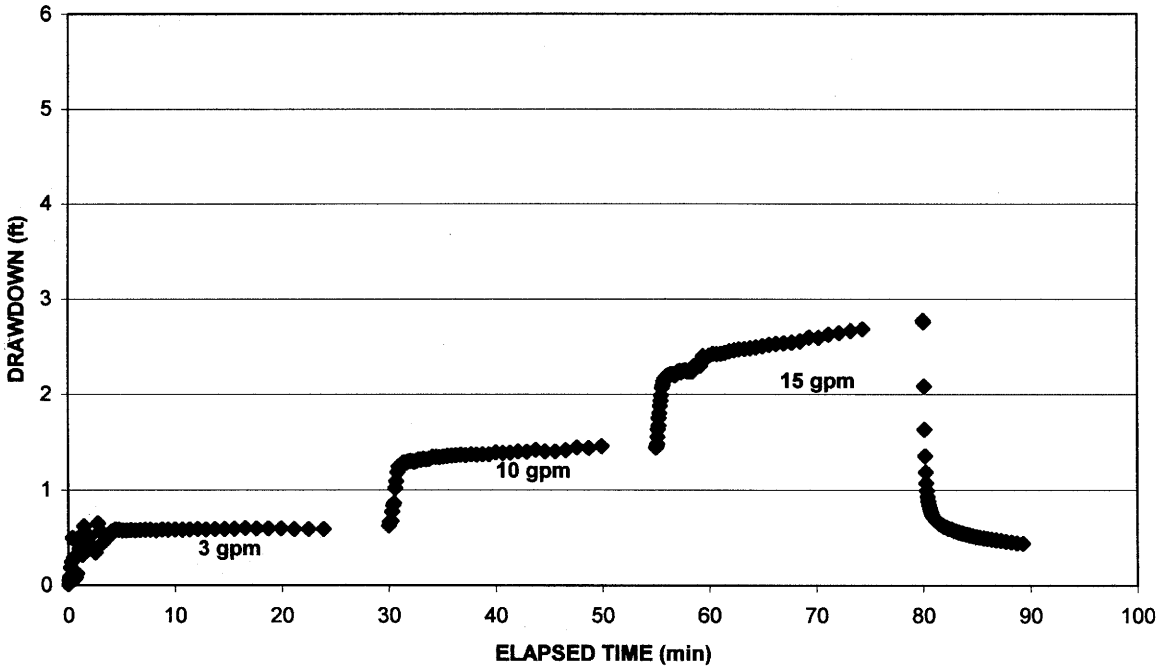
WELL 472



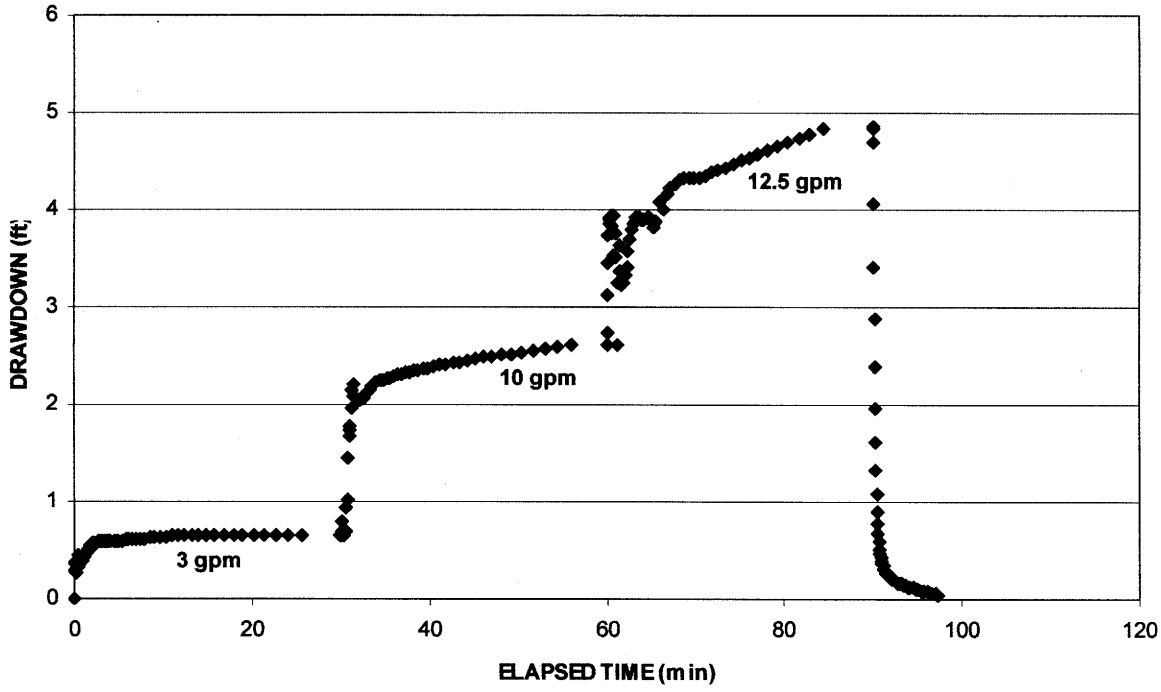
WELL 473



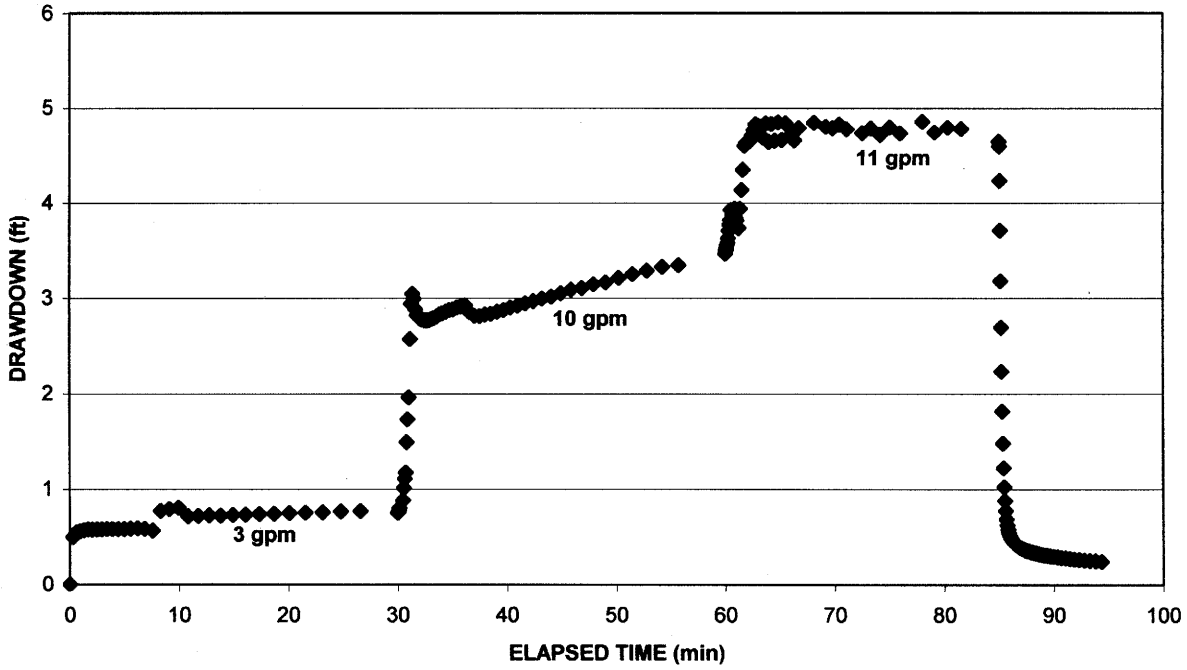
WELL 474



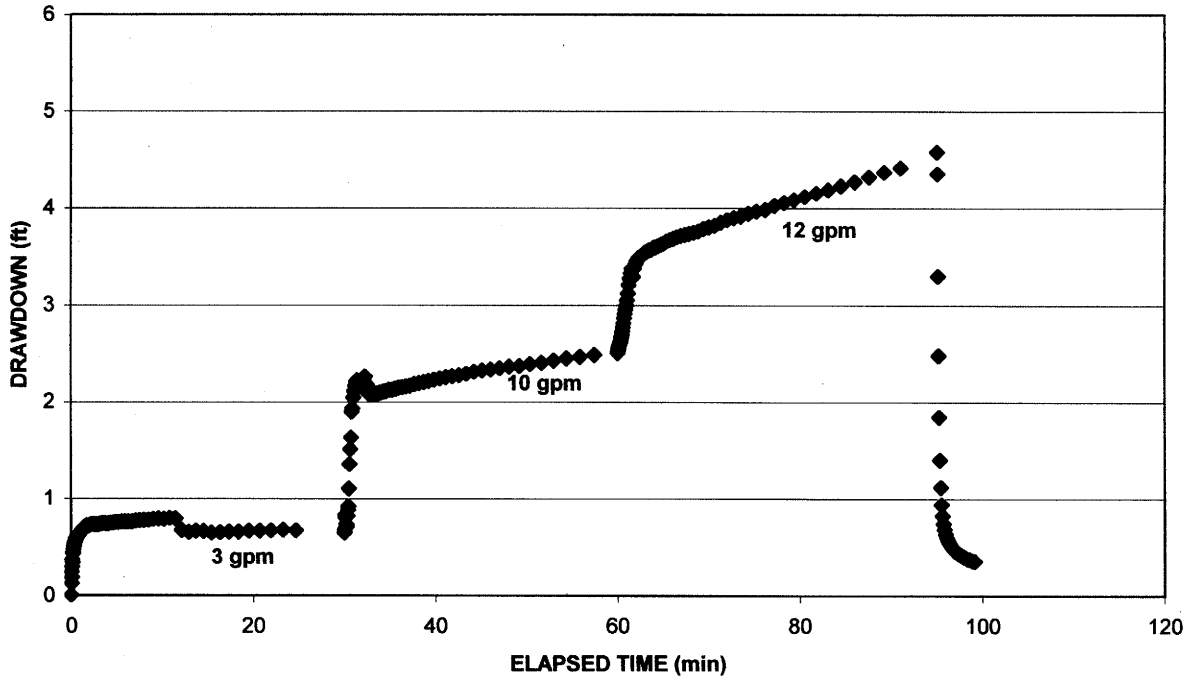
WELL 475



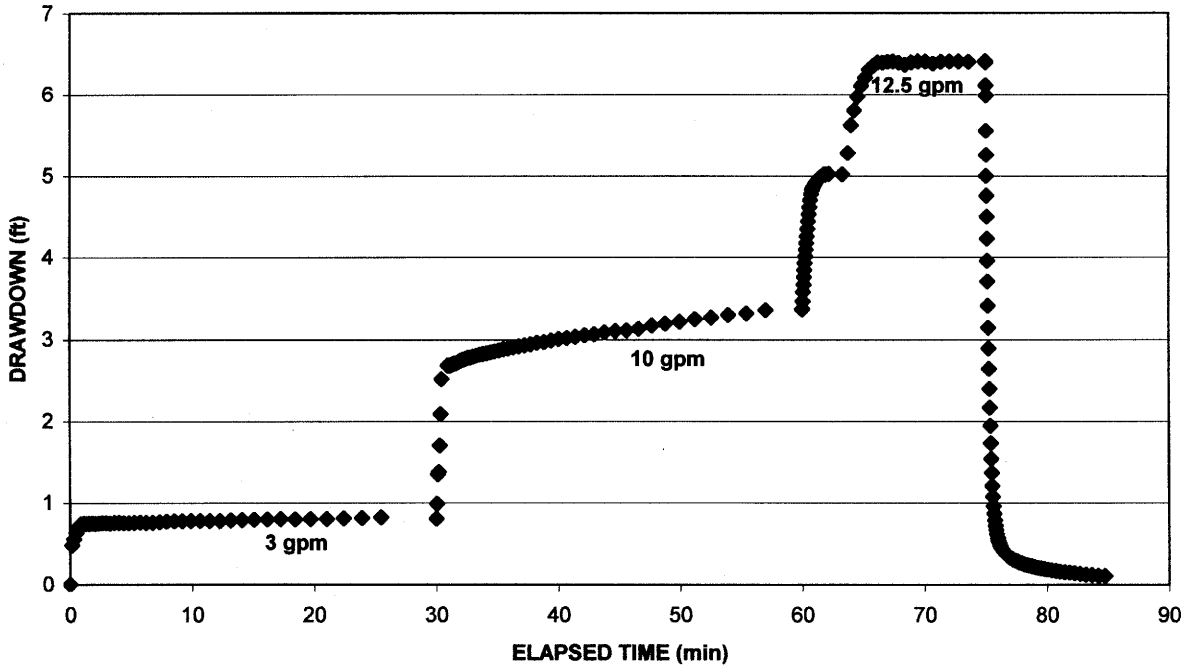
WELL 476



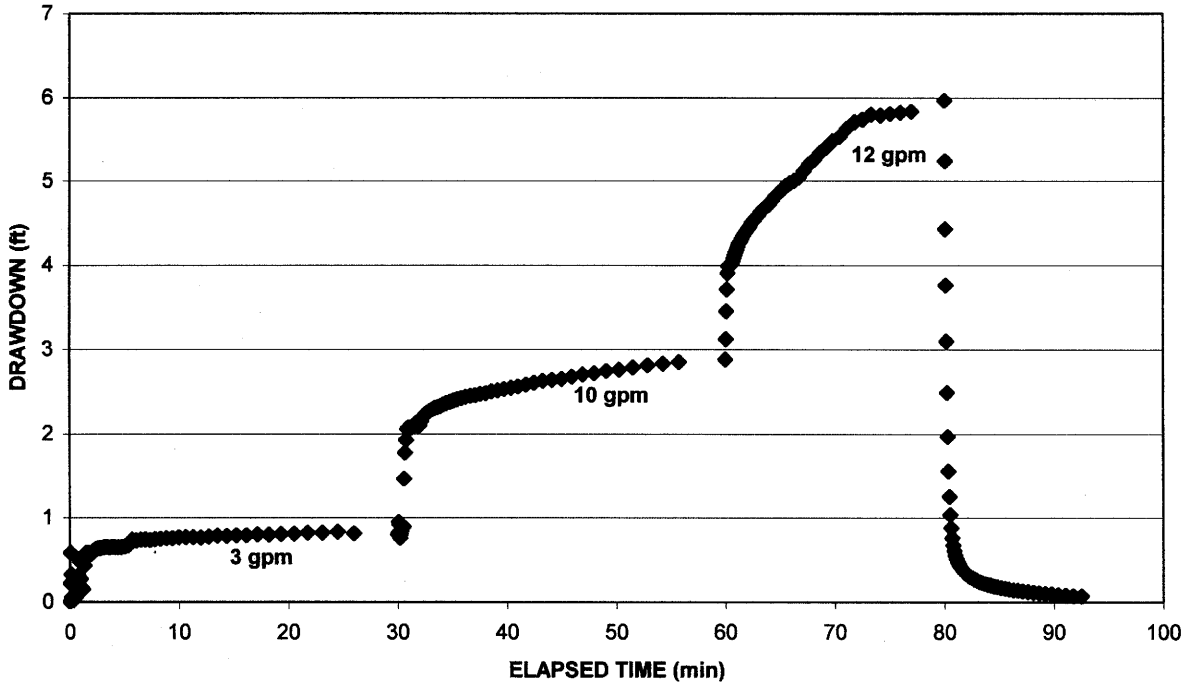
WELL 477



WELL 478



WELL 479



Appendix D

Equipment and Materials Cutsheets

Contents

Closeout Submittal-Liner Warranty

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

Colorado Lining International warrants workmanship performed by Colorado Lining International to be free of defects for five (5) year(s) from the date of acceptance.

This limited warranty does not include damages or defects in workmanship resulting from acts of God, including but not limited to earthquakes, floods, piercing hail, ice, tornadoes, wind, or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of seams to harmful chemicals, abuse of seams by machinery, equipment, or people, excessive pressure from any source, or strain from any source.

Any claim for any alleged breach of this warranty must be made in writing to the President of Colorado Lining International, by certified mail, within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the purchaser and purchaser shall have no right of recovery against Colorado Lining International. In the event said repairs are to be effected, said repairs shall not be due until the area subject to repair is in a clean, dry, unencumbered condition. This includes but is not limited to the area available for repair to be free from all water, dirt, sludge, residuals and liquids of any kind.

I hereby state that I have read and understand the above and foregoing Limited Warranty and agree to such by signing hereunder.

PURCHASER/USER: S.M. Stoller Corp / U.S. Department of Energy

ACCEPTED BY: Jud Hudson, Contract Administrator

COLORADO LINING INTERNATIONAL: _____

Colorado
(800) 524-8672
Texas
(888) 546-4641
Montana
(877) 448-2777

Colorado Lining INTERNATIONAL

California
(877) 578-5000
So. California
(888) 295-6100
South Dakota
(800) 661-2201

FOR GSE LINING TECHNOLOGY, INC.
(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

Date:	September 30, 2003	Warranty No.:	509539
Purchaser Name:	Department of Energy c/o S.M. Stoller	Project No.:	509539
Address:	2597 B ¾ Road	Effective Date:	August 13, 2003
City, State:	Grand Junction, Colorado 81503	Project Name:	Moab DOE
Product Type/Description:	GSE HD 40 mil	Project Address:	Palisade, Colorado

GSE Lining Technology, Inc. ("GSE") warrants each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of five (5) years from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product on a pro rata basis at the current price in such manner as to charge the Purchaser only for that portion of the warranted life which has elapsed since the purchase of the product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology, Inc., 19103 Gundle Road, Houston, Texas 77073, with the words "Warranty Claim" clearly marked on the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all warranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to perform any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free from all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

INSTALLATION WARRANTY

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

Colorado Lining International warrants workmanship performed by Colorado Lining International to be free of defects for five (5) year(s) from the date of acceptance.

This limited warranty does not include damages or defects in workmanship resulting from acts of God, including but not limited to earthquakes, floods, piercing hail, ice, tornadoes, wind, or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of seams to harmful chemicals, abuse of seams by machinery, equipment, or people, excessive pressure from any source, or strain from any source.

Any claim for any alleged breach of this warranty must be made in writing to the President of Colorado Lining International, by certified mail, within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the purchaser and purchaser shall have no right of recovery against Colorado Lining International. In the event said repairs are to be effected, said repairs shall not be due until the area subject to repair is in a clean, dry, unencumbered condition. This includes but is not limited to the area available for repair to be free from all water, dirt, sludge, residuals and liquids of any kind.

I hereby state that I have read and understand the above and foregoing Limited Warranty and agree to such by signing hereunder.

PURCHASER/USER: _____

ACCEPTED BY: _____

COLORADO LINING INTERNATIONAL: _____

Colorado
(800) 524-8672
Texas
(888) 546-4641
Montana
(877) 448-2777

Colorado Lining INTERNATIONAL

California
(877) 578-5000
So. California
(888) 295-6100
South Dakota
(800) 661-2201

INSTALLATION WARRANTY

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

Colorado Lining International warrants workmanship performed by Colorado Lining International to be free of defects for five (5) year(s) from the date of acceptance.

This limited warranty does not include damages or defects in workmanship resulting from acts of God, including but not limited to earthquakes, floods, piercing hail, ice, tornadoes, wind, or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of seams to harmful chemicals, abuse of seams by machinery, equipment, or people, excessive pressure from any source, or strain from any source.

Any claim for any alleged breach of this warranty must be made in writing to the President of Colorado Lining International, by certified mail, within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the purchaser and purchaser shall have no right of recovery against Colorado Lining International. In the event said repairs are to be effected, said repairs shall not be due until the area subject to repair is in a clean, dry, unencumbered condition. This includes but is not limited to the area available for repair to be free from all water, dirt, sludge, residuals and liquids of any kind.

I hereby state that I have read and understand the above and foregoing Limited Warranty and agree to such by signing hereunder.

PURCHASER/USER: _____

ACCEPTED BY: _____

COLORADO LINING INTERNATIONAL: _____

Colorado
(800) 524-8672
Texas
(888) 546-4641
Montana
(877) 448-2777

Colorado Lining INTERNATIONAL

California
(877) 578-5000
So. California
(888) 295-6100
South Dakota
(800) 661-2201

(GEOSYNTHETIC MANUFACTURED MATERIALS)
(U.S.A.)

Date:	September 30, 2003	Warranty No.:	509539
rchaser Name:	Department of Energy c/o S.M. Stoller	Project No.:	509539
Address:	2597 B ¾ Road	Effective Date:	August 13, 2003
City, State:	Grand Junction, Colorado 81503	Project Name:	Moab DOE
Product Type/Description:	GSE HD 40 mil	Project Address:	Palisade, Colorado

GSE Lining Technology, Inc. ("GSE") warrants each GSE product described above to be free from material manufacturing defects (as described by the contract's material specifications) and to be able to withstand normal weathering for a period of five (5) years from the above effective date for "normal use" in approved applications. This limited warranty does not include damages or defects in the GSE product resulting from acts of God, casualty or catastrophe, including but not limited to: earthquakes, floods, piercing hail, tornadoes or force majeure. The term "normal use" does not include, among other things, the exposure of GSE's product to harmful chemicals, abuse by machinery, equipment or people; improper site preparation or placement of cover materials; excessive pressures or stresses from any source. This warranty is intended for commercial use only and is not in effect for the consumer as defined in the Magnuson-Moss Warranty Act.

Should defects or premature loss of use within the scope of this warranty occur, GSE will, at its option, repair or replace the GSE product on a pro rata basis at the current price in such manner as to charge the Purchaser only for that portion of the warranted life which has elapsed since the purchase of the product. GSE shall have the right to inspect and determine the cause of the alleged defect in the product and to take appropriate steps to repair or replace the product if a defect exists that is covered under this warranty. This limited warranty only extends to the geosynthetic portion of this product manufactured by GSE and does not apply to any third-party manufactured materials attached to GSE's product. The third-party portion of the product will carry the original manufacturer's warranty that will be passed through to the Purchaser.

Any claim for any alleged breach of this warranty must be made in writing, by certified mail or courier, to GSE Lining Technology, Inc., 19103 Gundle Road, Houston, Texas 77073, with the words "Warranty Claim" clearly marked on the envelope, within ten (10) days of Purchaser becoming aware of the alleged defect. Should the required notice not be given, the defect and all ranties are waived by the Purchaser, and Purchaser shall not have rights under this warranty. GSE shall not be obligated to orm any inspection or obligated to perform any repair or replacement under this warranty until the area is made available free rom all obstructions, water, dirt, sludge, residuals and liquids of any kind. If after inspection it is determined that there is no claim under this warranty, Purchaser shall reimburse GSE for its costs associated with the site inspection.

In the event the exclusive remedy provided herein fails in its essential purpose, and in that event only, the Purchaser shall be entitled to a return of the purchase price for so much of the product as GSE determines to have violated the warranty provided herein. GSE shall not be liable for direct, indirect, special, consequential or incidental damages resulting from a breach of this warranty including, but not limited to: damages for loss of production, lost profits, personal injury or property damage. GSE shall not be obligated to reimburse Purchaser for any repairs, replacement, modifications or alterations made by Purchaser to GSE's product, unless GSE specifically authorized, in writing, said repairs, replacements, modifications or alterations in advance. GSE liability under this warranty shall in no event exceed the replacement cost of the product sold to the Purchaser for the particular installation in which it failed.

GSE neither assumes nor authorizes any person other than an officer of GSE to assume for it any other or additional liability in connection with the GSE product made on the basis of the Limited Warranty. **GSE MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN HEREIN AND HEREBY DISCLAIMS ALL WARRANTIES, INCLUDING BOTH EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, AND BY ACCEPTING DELIVERY OF THE PRODUCT, PURCHASER WAIVES ALL OTHER POSSIBLE WARRANTIES. GSE's WARRANTY BECOMES AN OBLIGATION OF GSE TO PERFORM UNDER THE WARRANTY ONLY UPON RECEIPT OF FINAL PAYMENT.**

This warranty is extended to the Purchaser and is non-transferable and non-assignable, i.e. there are no third-party beneficiaries to this warranty.

CONTRACTOR: **Palisade Constructors**

ENGINEER: **SM Stoller Corporation**

PROJECT: **Moab DOE**

DATE OF ACCEPTANCE: **8/13/03**

MATERIAL: **40 mil HDPE**

Colorado Lining International warrants workmanship performed by Colorado Lining International to be free of defects for five (5) year(s) from the date of acceptance.

This limited warranty does not include damages or defects in workmanship resulting from acts of God, including but not limited to earthquakes, floods, piercing hail, ice, tornadoes, wind, or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of seams to harmful chemicals, abuse of seams by machinery, equipment, or people, excessive pressure from any source, or strain from any source.

Any claim for any alleged breach of this warranty must be made in writing to the President of Colorado Lining International, by certified mail, within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the purchaser and purchaser shall have no right of recovery against Colorado Lining International. In the event said repairs are to be effected, said repairs shall not be due until the area subject to repair is in a clean, dry, unencumbered condition. This includes but is not limited to the area available for repair to be free from all water, dirt, sludge, residuals and liquids of any kind.

I hereby state that I have read and understand the above and foregoing Limited Warranty and agree to such by signing hereunder.

PURCHASER/USER: _____

ACCEPTED BY: _____

COLORADO LINING INTERNATIONAL: _____

Colorado
(800) 524-8672
Texas
(888) 546-4641
Montana
(877) 448-2777

Colorado Lining INTERNATIONAL

California
(877) 578-5000
So. California
(888) 295-6100
South Dakota
(800) 661-2201

Product Data

GSE

Product Data Sheet

GSE STANDARD PRODUCTS

GSE HD

GSE HD is a smooth, high quality, high density polyethylene (HDPE) geomembrane produced from specially formulated, virgin polyethylene resin. This polyethylene resin is designed specifically for flexible geomembrane applications. It contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. GSE HD has outstanding chemical resistance, mechanical properties, environmental stress crack resistance, dimensional stability and thermal aging characteristics. GSE HD has excellent resistance to UV radiation and is suitable for exposed conditions. *These product specifications meet or exceed GRI GM13.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, mils (mm)	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Thickness, mils (mm)	ASTM D 5199	every roll	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	420 (128)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2341)	19,575 (1819)	12,600 (1171)	9,675 (899)	1,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS005 R10/01/02

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE Internal Specification Review

Clarifications

Project No. 509539
Project: Moab Tailings West Cell
Products: **1)** 40 mil Minimum Smooth HDPE Geomembrane; **2)** 16 oz/yd2 Nonwoven Geotextile
Sections: **Section 02271** page 6 of 14

Date: 15 May, 2003

Level 1 Exceptions
Page 02271-6 Section 2.2.B

Geomembrane Property	Project Specifications	GSE Specifications
Modulus at 100%	ASTM D638	Not Tested
Carbon Black Dispersion	Cat 1 or 2	9 of 10 views in Cat 1 or 2. No more than 1 view in Cat 3.

Level 2 Exceptions

Geomembrane Property	Project Specifications	GSE Specifications
Thickness	ASTM D1593	ASTM D5199
Density	ASTM D792	ASTM D792 or 1505

Level 3 Exceptions
None

SPECIFICATIONS

3 and 8 strand standard construction

September 1990 100

resistent to rot, U.V. abrasion grease gas chemicals marine growth

SIZE		POLYPRO		NYLON		POLYESTER		POLY-PLUS®		STEEL-LITE®		MANILA		WORKING LOADS*
DIA.	CIR.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	★
3/16"	5/8"	800	.70	1,000	1.0	1,000	1.2	—	—	—	—	408	1.5	10:1
1/4"	3/4"	1,250	1.2	1,650	1.6	1,650	2.0	1,300	1.7	—	—	540	2.0	10:1
5/16"	1	1,900	1.8	2,560	2.5	2,550	3.1	2,000	2.6	—	—	900	2.8	10:1
3/8"	1 1/8"	2,700	2.8	3,700	3.5	3,700	4.5	3,200	3.6	—	—	1,220	4.1	10:1
7/16"	1 1/4"	3,500	3.8	6,000	5.0	5,000	6.2	3,800	4.8	—	—	1,580	5.3	10:1
1/2"	1 1/2"	4,200	4.7	8,400	6.5	6,400	8.0	5,400	6.7	—	—	2,380	7.5	9:1
9/16"	1 3/4"	5,100	6.1	8,900	8.3	8,000	10.2	8,000	7.6	—	—	3,100	10.4	8:1
5/8"	2"	6,200	7.5	10,400	10.5	10,000	13.0	7,200	9.2	—	—	3,980	13.3	8:1
3/4"	2 1/4"	8,800	10.7	14,200	14.5	12,600	17.5	9,800	12.5	—	—	4,860	16.7	7:1
13/16"	2 1/2"	9,900	12.7	17,000	17.0	15,500	21.0	11,200	14.7			5,850	19.5	7:1
7/8"	2 3/4"	11,500	15.0	20,000	20.0	18,000	25.0	13,600	17.6	--	—	8,960	22.4	7:1
1"	3"	14,000	18.0	25,000	28.4	22,000	30.4	17,000	22.0	—	—	8,100	27.0	7:1
1 1/16"	3 1/4"	18,000	20.4	28,800	29.0	25,500	34.4	18,700	24.5	—	—	9,450	31.2	7:1
1 1/8"	3 1/2"	18,300	23.6	30,000	34.0	29,500	40.0	21,000	27.5	—	—	10,800	34.0	7:1
1 1/4"	3 3/4"	21,000	27.0	37,500	40.0	33,200	48.2	25,000	33.0	—	—	12,200	41.6	7:1
1 5/16"	4"	23,300	30.4	43,000	46.0	37,600	62.5	27,800	37.0	—	—	13,500	47.8	7:1
1 1/2"	4 1/2"	28,700	38.4	53,000	55.0	46,800	87.0	34,000	46.0	38,000	36.6	16,700	60.0	7:1
1 5/8"	5"	36,000	47.6	66,000	66.5	57,000	82.0	41,000	55.0	46,000	45.1	20,800	74.5	7:1
1 3/4"	5 1/2"	43,000	59.0	78,000	80.0	67,800	98.0	51,000	68.0	55,000	54.2	23,800	88.5	7:1
2"	6"	52,000	69.0	92,000	95.0	60,000	118.0	62,000	80.0	68,500	65.6	28,000	108.0	7:1
2 1/8"	6 1/2"	61,000	80.0	108,000	108.0	82,000	136.0	70,000	97.0	77,500	76.5	—	—	7:1
2 1/4"	7"	68,000	92.0	125,000	129.0	107,000	157.0	78,000	108.0	88,000	87.0	—	—	8:1
2 1/2"	7 1/2"	80,000	107.0	140,000	148.0	122,000	181.0	90,000	122.0	103,000	102.0	—	—	8:1
2 5/8"	8"	90,000	120.0	162,000	168.0	137,000	205.0	89,000	138.0	116,000	114.0	—	—	6:1
2 3/4"	8 1/2"	101,000	137.0	180,000	189.0	154,000	230.0	110,000	165.0	130,900	130.0	—	—	6:1
3"	9"	114,000	153.0	200,000	210.0	174,000	258.0	125,000	179.0	145,000	145.0	—	—	6:1
3 1/4"	10"	137,000	190.0	230,000	264.0	210,000	318.0	150,000	215.0	175,000	180.0	—	—	6:1
3 1/2"	11"	162,000	232.0	300,000	312.0	254,000	384.0	170,000	248.0	207,000	220.0	—	—	8:1
4"	12"	190,000	275.0	380,000	380.0	300,000	460.0	200,000	290.0	243,000	261.0	—	—	8:1

DIA.	DACRON® All Dacron Polyester		LIST MOORING LINE		POLY-CRON®		SUPER 800 LOCK LINE	
	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.	Tensile Strength	Lbs. Per 100 Ft.
1 1/2"	—				34,000	55.0	35,500	44.0
1 5/8"	—	—	—	—	42,000	67.0	43,500	54.0
1 3/4"	87,000	96.0	59,000	67.0	50,000	80.0	53,000	66.0
2"	103,500	118.0	70,500	80.0	60,000	95.0	63,000	78.0
2 1/8"	117,800	136.0	82,500	94.0	70,000	112.0	—	—
2 1/4"	136,000	157.0	95,000	109.0	80,000	127.0	86,500	106.0
2 1/2"	158,000	181.0	110,000	125.0	92,000	147.0	—	—
2 5/8"	175,000	205.0	120,000	142.0	106,000	165.0	104,000	138.0
2 3/4"	195,000	230.0	135,000	155.0	120,000	190.0	—	—
3"	217,900	258.0	150,000	175.0	130,000	208.0	140,000	175.0
3 1/4"	266,000	318.0	180,000	210.0	163,000	253.0	170,000	215.0
3 1/2"	318,000	384.0	220,000	245.0	—	—	—	—
4"	377,000	460.0	260,000	296.0	—	—	—	—

FOLLOWING IN 8 STRAND CONSTRUCTION ONLY

DIA.	CIR.	POLYPRO Tensile Strength	POLYPRO Lbs. Per 100 Ft.	NYLON Tensile Strength	NYLON Lbs. Per 100 Ft.	POLYESTER Tensile Strength	POLYESTER Lbs. Per 100 Ft.	POLY-PLUS Tensile Strength	POLY-PLUS Lbs. Per 100 Ft.	STEEL-LITE Tensile Strength	STEEL-LITE Lbs. Per 100 Ft.	MANILA Tensile Strength	MANILA Lbs. Per 100 Ft.	WORKING LOADS	DACRON Tensile Strength	DACRON Lbs. Per 100 Ft.
4 1/4"	13"	220,000	320.0	440,000	450.0	350,000	540.0	270,000	385.0	290,000	309.0	—	—	6:1	435,000	540.0
4 1/2"	14"	252,000	365.4	510,000	500.0	410,000	626.0	315,000	447.0	316,000	356.0	—	—	6:1	505,000	626.0
5"	15"	290,000	420.0	575,000	570.0	467,000	720.0	360,000	513.0	358,000	409.0	—	—	6:1	575,000	720.0
5 1/4"	16"	330,000	475.0	650,000	645.0	535,000	820.0	410,000	585.0	402,000	468.0	—	—	6:1	655,000	820.0
5 5/8"	17"	366,000	530.0	720,000	715.0	600,000	920.0	460,000	662.0	445,000	527.0	—	—	6:1	725,000	920.0
6"	18"	410,000	594.0	800,000	795.0	675,000	1010.0	515,000	747.0	500,000	593.0	—	—	6:1	825,000	1040.0

TENSILE STRENGTHS shown are average based on new ropes tested under laboratory conditions and can vary by 10%. WEIGHTS are average and may vary by 5%.

★ WORKING LOADS are expressed as a ratio to tensile strength.

8 STRAND ROPES not available in Manila or sizes under 1 1/2" dia. Consult customer service department.

MANILEX—same specs as Polypro.

SUBMITTAL REVIEW

Review is [illegible] general conformity with the design concept and is limited to [illegible] as called for in contract documents. Subcontractor [illegible] responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

___ No Exceptions Taken
_X_ Furnish as Corrected
___ Amend and resubmit
___ Rejected

Date 8/15/03 Department

*CAUTION: USE OF WORKING LOADS

Because of the wide range of rope use, rope condition, exposure to the several factors affecting rope behavior, and the degree of risk to life and property involved, it is impossible to make blanket recommendations as to working loads. However, to provide guidelines, working loads are tabulated for rope in good condition with appropriate splices, in non-critical applications and under normal service conditions.

A higher working load may be selected only with expert knowledge of conditions and professional estimate of risk and if the rope has not been subject to dynamic loading or other excessive use, has been inspected and found to be in good condition and is to be used in the recommended manner and the application does not involve elevated temperatures, extended periods under load, or obvious dynamic loading (see explanation below) such as sudden drops, snubs, or pickups. For all such applications and for applications involving more severe exposure conditions, or for recommendations on special applications, consult the manufacturer.

Many uses of rope involve serious risk of injury to personnel or damage to valuable property. This danger is often obvious, as when a heavy load is supported above one or more workmen. An equally dangerous situation occurs if personnel are in line with a rope under tension. Should the rope fail, it may recoil with considerable force. Persons should be warned against the serious danger of standing in line with any rope under tension. IN ALL CASES WHERE SUCH RISKS ARE PRESENT, OR THERE IS ANY QUESTION ABOUT THE LOADS INVOLVED OR THE CONDITIONS OF USE, THE WORKING LOAD SHOULD BE SUBSTANTIALLY REDUCED AND THE ROPE PROPERLY INSPECTED.

DYNAMIC LOADING VOIDS NORMAL WORKING LOAD

Normal working loads are not applicable when rope is subject to significant dynamic loading. Whenever a load is picked up, stopped, moved or swung there is an increased force due to dynamic loading. The more rapidly or suddenly such actions occur, the greater the increase will be. In extreme cases, the force [illegible]

Examples could be picking up a tow on a slack line or using a rope to stop a falling object. Therefore, in all such applications as towing lines, lifelines, safety lines, climbing ropes, etc., working loads as given DO NOT APPLY.

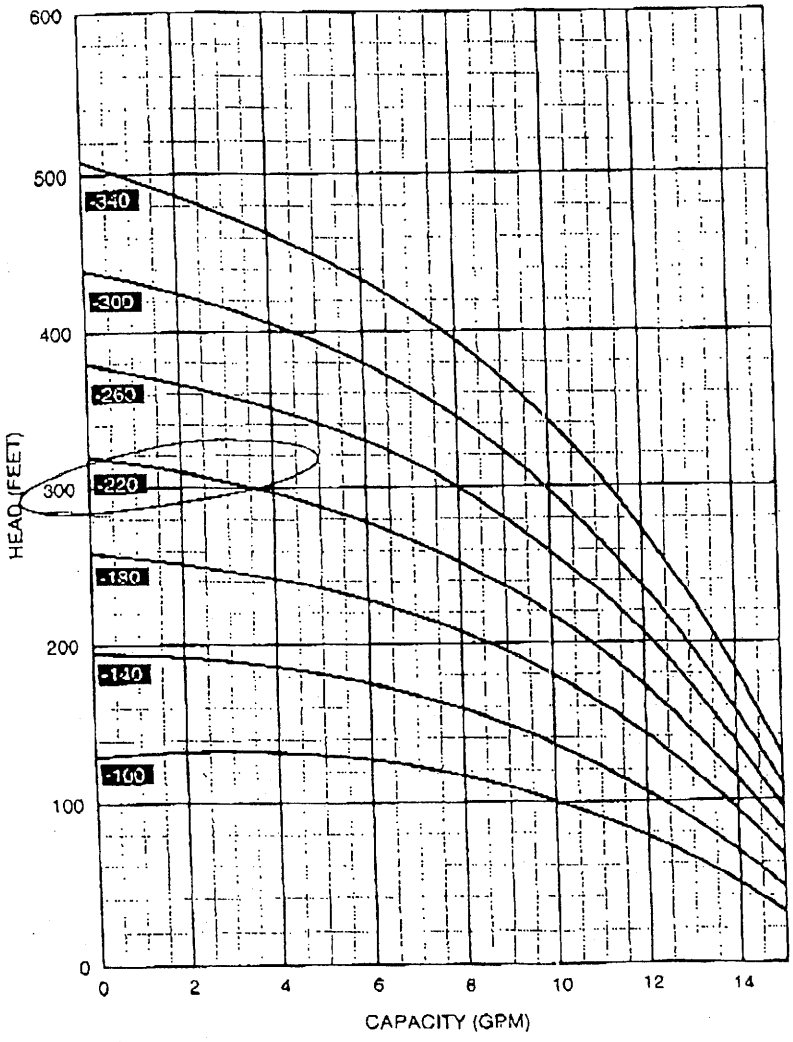
Users should be aware that dynamic effects are greater on a low elongation rope such as polyester than on a high elongation rope such as nylon, and greater on a shorter rope than on a longer one. The working load ratios listed contain provision for very modest dynamic loads. This means, however, that when this working load has been used to select a rope, the load must be handled slowly and smoothly to minimize dynamic effects and avoid exceeding the provision for them.

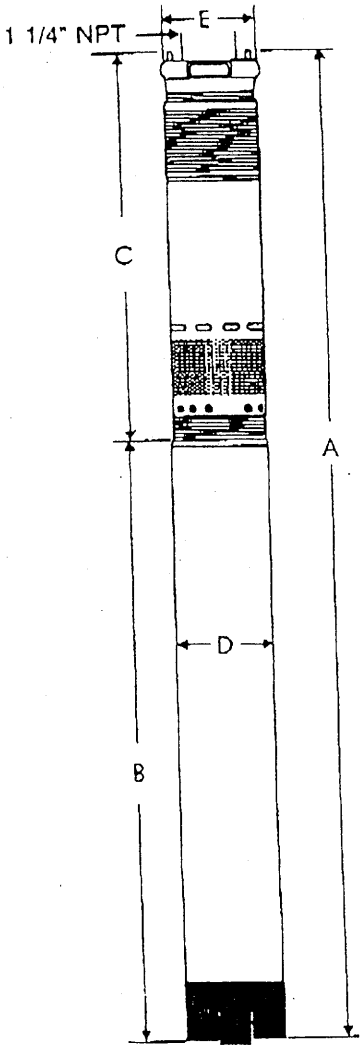
EFFECT OF TEMPERATURE ON TENSILE STRENGTH

The tensile strength charts apply to ropes tested at normal room temperature (70°F). Ropes have lower tensile strengths at higher temperatures. 30% (or more) lower at the boiling point of water (212°F) and continuing on down to zero [illegible]

Model #	HP	Size	Disch. Size	Dimensions in Inches					Approx. Ship Wt.
				A	B	C	D	E	(pounds)
10Redi-Flo3-100	1/3A	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10Redi-Flo3-140	1/2A	3"	1 1/4" NPT	30.4	19.8	10.6	2.6	2.9	12
10Redi-Flo3-180	1/2B	3"	1 1/4" NPT	31.5	19.8	11.6	2.6	2.9	13
10Redi-Flo3-220	3/4B	3"	1 1/4" NPT	33.6	19.8	13.7	2.6	2.9	13
10Redi-Flo3-260	1C	3"	1 1/4" NPT	35.0	21.3	13.7	2.6	2.9	16
10Redi-Flo3-300	1C	3"	1 1/4" NPT	36.1	21.3	14.8	2.6	2.9	16
10Redi-Flo3-340	1 1/2C	3"	1 1/4" NPT	38.2	21.3	16.9	2.6	2.9	16

Note: Weights include pump ends with motors

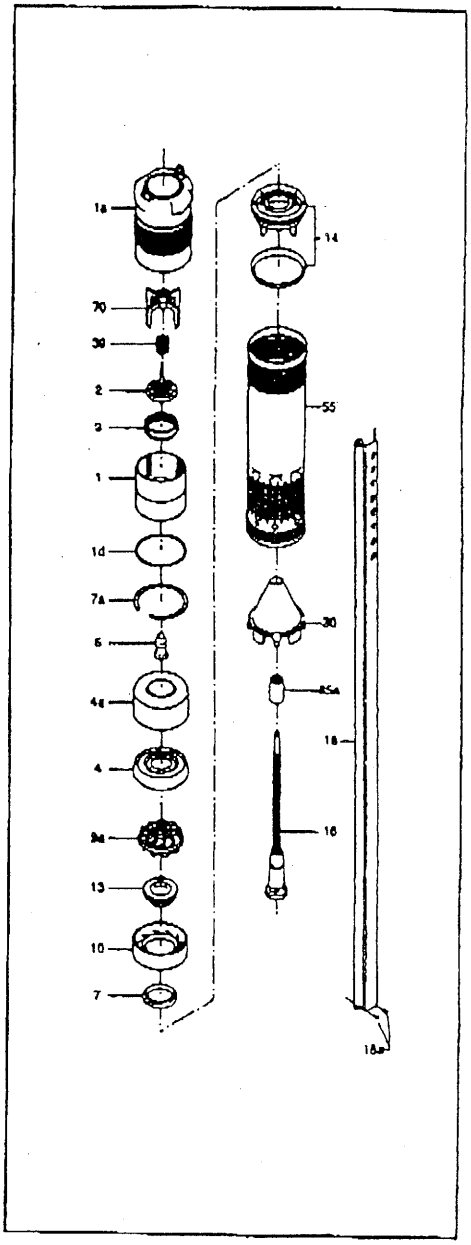




GRUNDFOS

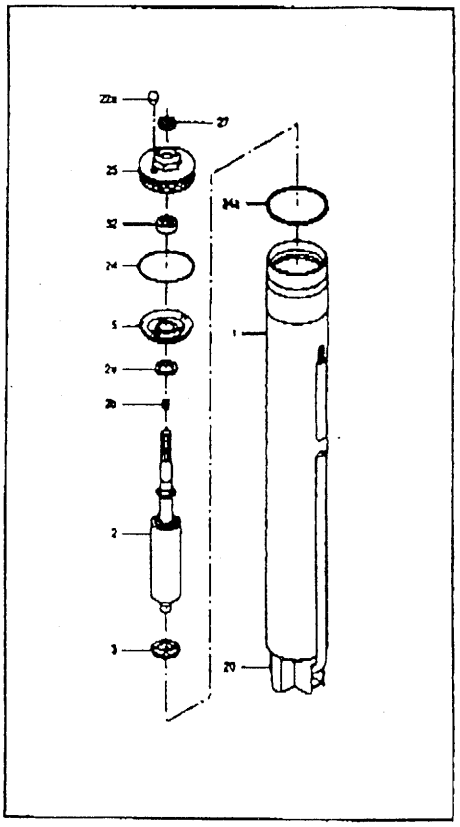
MATERIAL SPECIFICATION – REDI-FLO3 PUMP END

Pos.	Component	Material	DIN W. Nr.	AISI
1	Valve Casing	PVDF		
1a	Discharge Chamber	Stainless Steel	1.4401	316
1d	O-Ring	FPM Rubber		
2	Valve Cone	PVDF		
3	Valve Seat	FPM Rubber		
4	Top Chamber	PVDF		
4a	Empty Chamber	PVDF		
6	Top Bearing	FPM Rubber		
7	Neck Ring	PVDF		
7a	Lock Ring	Stainless Steel	1.4401	316
9a	Guide Vanes	PVDF		
10	Bottom Chamber	PVDF		
13	Impeller w/ tungsten carbide bearing	PVDF		
14	Suction Interconnector	PVDF		
14a	Ring	Stainless Steel	1.4401	316
16	Shaft w/ coupling	Stainless Steel	1.4401	316
		Sintered Steel		
18	Cable Guard	Stainless Steel	1.4401	316
18a	Cable Guard Screws	Stainless Steel	1.4401	316
30	Pressure Equalization Cone	PVDF		
39	Valve Spring	Stainless Steel	1.4406	316LN
55	Pump Sleeve	Stainless Steel	1.4401	316
70	Valve Guide	PVDF		
85a	Spacer	Stainless Steel	1.4401	316



MATERIAL SPECIFICATION – REDI-FLO3 PUMP MOTOR

Pos.	Component	Material	DIN W. Nr.	AISI
1	Stator	Stainless Steel	1.4401	316
2	Rotor	Stainless Steel	1.4401	316
2a	Stop Ring	PP		
2b	Filter	Polyester		
3	Thrust Bearing	Carbon		
5	Radial Bearing	Ceramic/ tungsten carbide		
20	Motor Cable w/ plug	Tefzel		
		PVDF		
22a	Filling Plug	FPM Rubber		
24	O-Ring	FPM Rubber		
24a	O-Ring	FPM Rubber		
25	Top Cover	PPS		
27	Filter	Polyester		
32	Shaft Seal	FPM Rubber		
	Motor Liquid	SML-2		



ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft-start
Run-up Time:	Maximum: 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Service Factor:	0.33-0.50A[Hp]-1.75 at 115V/230V 0.50-0.75B[Hp]-1.4 at 230V 1.0-1.5C[Hp]-1.15 at 230V
Motor Cable:	3 Wire, Tefzel Cable Kit
Motor Liquid:	Type SML 2
pH Values:	4-9
Liquid Temperature:	The temperature of the pumped liquid should not exceed 104°F.
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump is to be stored after use, it must be stored in a frost-free location or it must be ensured that the motor liquid is frost-proof. Otherwise motor must be stored without being filled with motor liquid.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	-4°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE - NE 3):	
0.33-0.50A[Hp]	20.9" length x 2.68" diameter
0.50-0.75B[Hp]	20.9" length x 2.68" diameter
1.0-1.5C[Hp]	22.3" length x 2.68" diameter
Pump Diameter, incl. cable guard:	2.91"
Motor Weights (MSE - NE 3):	
0.33-0.50A[Hp]	6.0 lbs
0.50-0.75B[Hp]	7.1 lbs
1.0-1.5C[Hp]	8.2 lb
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions (min. and max.):	
5 Redi-Flo3	10.6" to 18.0"
10 Redi-Flo3	10.6" to 16.9"
15 Redi-Flo3	10.6" to 16.9"
22 Redi-Flo3	10.6" to 16.9"
30 Redi-Flo3	10.6" to 13.7"
Pump End Weights (min. and max.):	
All	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (maximum):	500 feet, below static water level

JUMBO BOX

JUMBO BOX ASSEMBLIES

Assembly Weight = 17.7 Pounds
Skid Quantity = 48
Skid Weight = 850 Pounds

Control Valve	
Black Box, Green Lid w/Snap Lock	190106
Black Box, Green Lid w/Pentagon Lock	190121
Black Box, Brown Mulch Lid w/Snap Lock	190125
Electric	
Black Box, Black Lid w/Pentagon Lock	190104
Black Box, Black Lid w/Snap Lock	190117
Black Box, Black Lid w/Hex Bolt Lock	190129
Water	
Black Box, Black Lid w/Snap Lock	190109
Black Box, Black Reader Lid w/Snap Lock	190107
Reclaimed Water	
Black Box, Purple Lid w/Snap Lock ***NEW COLOR!***	190122
CATV	
Black Box, Green Lid w/Snap Lock	190112
Blank	
Black Box, Green (Blank) Insulator Lid, 6" Extension	190133

JUMBO BOX (Boxes Only)

Box Weight = 11.9 Pounds
Skid Quantity = 48
Skid Weight = 610 Pounds

Black	190101
Black Box w/3 - 6" Extensions	190130

JUMBO BOX (Lids Only)

Lid Weight = 5.8 Pounds
Skid Quantity = 132
Skid Weight = 810 Pounds

Green (Blank), no Lock, use with 190131 Insulator	190135
Green (Blank) w/Snap Lock	192103
Green "Control Valve" w/Snap Lock	192101
Green "Control Valve" w/Pentagon Lock	192109
Brown Mulch "Control Valve" w/Snap Lock	192112
Brick Red "Control Valve" w/Snap Lock	192113
Black "Electric" w/Snap Lock	191102
Black "Electric" w/Pentagon Lock	191105
Black "Water" w/Snap Lock	191101
Purple "Reclaimed Water" w/Pentagon Lock	192012
Purple "Reclaimed Water" w/Snap Lock	192[illegible]10

JUMBO BOX EXTENSIONS

Black, 6" Height	190110

Extension Weight = [illegible] Pounds
Skid Quantity = 40
Skid Weight = 280 Pounds

Black 6" Height and Green "Control Valve" Lid w/Snap Lock	190115

Assembly Weight = 11.8 Lbs.
Skid Quantity = 32
Skid Weight = 420 Lbs.

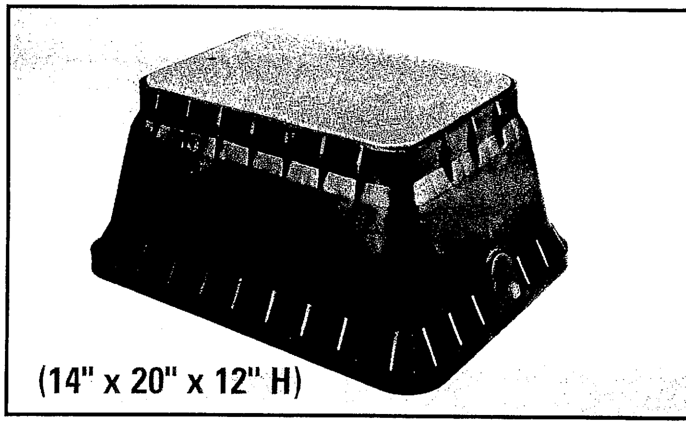
SUBMITTAL REVIEW
Review is only for general conformity with the design conc[illegible] is limited to requirements called for by the contract docume[illegible] sub-contractor is responsible for the accuracy of dimensions, [illegible] and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques [illegible]ation or construction.
X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected
Date 6/21/03 Department ENG
Mr Madiz

JUMBO BOX BOTTOM

Flat Base for Jumbo Box	190132

JUMBO BOX ACCESSORIES

Insulator (Used only with 190135 Lid)	190131
Lexan Bolt-Pentagon Lock	143003
Lexan Locking Nut-Pentagon Lock	143013
Hexagon Steel Bold	143014
8" Hinge Pin (for #172002 & 172114)	144004
Snap Lock Set	144017
Snap Lock Unlocking Tool (A)	144022
Locator Washer	143020
Screw for Locator Washer	143004

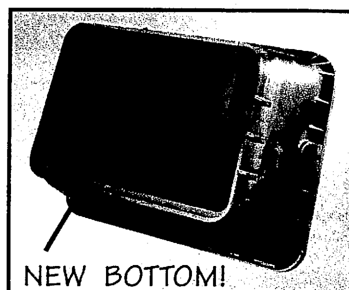


(14" x 20" x 12" H)

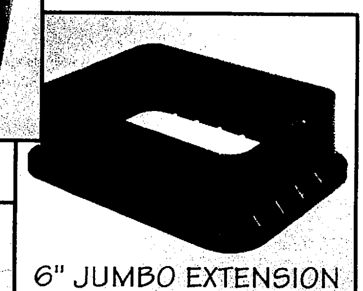
FEATURES:

- 10 Year Lid Guarantee
- Allows More Space
- Ametek's SUPERFLEXON® is Easier to Handle, Install, and Store
- Reader Lid Available

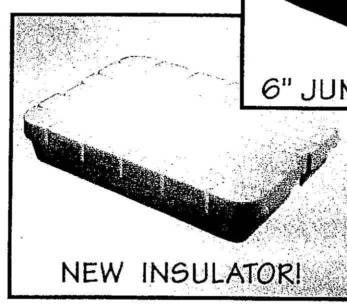
10 YEAR LID GUARANTEE
AMETEK ACCESS BOXES



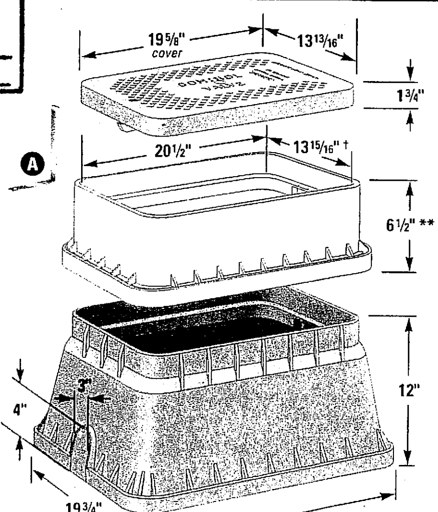
NEW BOTTOM!

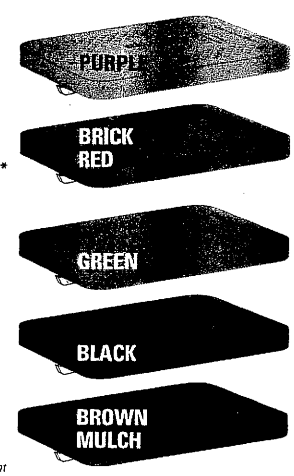


6" JUMBO EXTENSION



NEW INSULATOR!





**6" effective height
†20" x 13 15/16" ID (18 3/4" x 12 11/16" min.)

Manufacturer’s Recommendations for Pipe

INSTALLATION PROCEDURES FOR JOINING PVC PIPE

1. Pipe is cut square with the axis, using a fine tooth hand saw and a miter box or a fine toothed power saw with a suitable guide. All burrs should be removed with a knife, file or abrasive paper.

2. Surfaces to be joined should be clean and free of moisture. Clean surfaces with a clean, dry cloth and PVC solvent. Remove gloss from the mating surfaces with abrasive paper or steel wool.

3. Keep cement can closed and in a shady place when not in use. Discard the cement if it does not flow freely from the brush or if it appears lumpy and stringy.

4. Apply the PVC solvent cement as quickly as possible, as it is very fast drying. Quick application is very important to minimize condensation of moisture from the air on the cement surface, under conditions of high atmospheric humidity. The surface temperature of the mating surfaces should not exceed 110°F at the time of assembly. The pipe temperature may be reduced by swabbing the surfaces to be cemented with clean wet rags, provided all water is removed before the cement is applied. First, using a scrubbing motion, apply primer to both surfaces that are to be joined. Then apply a full even coat of cement to the pipe surface, to the depth of the fitting socket. Next, apply a uniform, thin coating of cement to the interior of the fitting socket, including the shoulders of the socket bottom. Recoat the pipe with a second uniform coat of cement, including the cut end of the pipe.

5. **NOTE:** The procedure above may be followed in the case of bell end pipe except that great care should be taken not to apply an excess of cement in the bell socket, nor should any cement be applied on the bell-to-pipe transition area. This precaution is particularly important for installation of bell end pipe with a wall thickness of less than 1/8".

6. Immediately after applying the last coat of cement to the pipe, insert the pipe into the fitting until it bottoms at the fitting shoulder. Turn the pipe or fitting 1/4 turn during assembly to evenly distribute cement. Hold the joints securely for approximately one minute for the cement to set. After assembly, wipe excess cement from the pipe at the end of the fitting socket.

7. Handle the newly assembled joints carefully until the cement has gone through a set period. Allow at least two hours before disturbing the pipe after the joint is made. This should be extended to four hours in extremely cold temperatures. Allow at least 12 hours before applying pressure to the line, as usually you do not get a complete cure for 24 to 48 hours.

8. After the set period, the pipe can be carefully placed in prepared ditch and snaked from side to side. It is best to place the pipe in the ditch early in the morning, rather than assembling the pipe in the heat of the day and laying it into the ditch at night, where it would cool rapidly. It is important that the line be pressure-tested before covering.

9. Because the tolerances are different on Schedule 80 vs. other types of PVC pipe, it is necessary that the installer use a heavy-bodied or Heavy Duty Cement. In addition, the curing time mentioned in Paragraph 7 above should be tripled for Schedule 80 pipe installation.

The above information was taken from the Plastics Pipe Institute Technical Report #10. If additional information is needed, write to: Plastics Pipe Institute, 355 Lexington Avenue, New York, New York 10017.

Eagle Plastics, Inc.

146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

EAGLE PLASTICS COMMITTED TO QUALITY

NSF TESTING LABORATORY ANN ARBOR

SPECIFICATION SHEET
Effective June 1, 1992

REVIEW
Review ... limited to ... design concept and is ... contract documents. Sub- contract... and detail... dimensions, quantities and for ... or equipment, tion or co... ues of fabrica-

X No Exceptions Taken
Corrected
... and Resubmit
Rejected

Date 6/27/03 Department ENG
By D.N.

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 21-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 40 Pressure Pipe Available in BOE	1/2"	.840	.612	.109	600	16.40	12000'	28
	3/4"	1.050	.824	.113	480	21.80	8100'	28
	1"	1.315	1.049	.133	450	32.10	6300'	28
	1¼"	1.660	1.380	.140	370	43.40	3920'	28
	1½"	1.900	1.610	.145	330	51.80	3020'	28
	2"	2.375	2.067	.154	280	69.50	2100'	28
	2½"	2.875	2.469	.203	300	109.60	1460'	28
	3"	3.500	3.068	.216	260	143.50	920'	28
	4"	4.500	4.026	.237	220	209.41	580'	28
	5"	5.563	5.047	.258	190	284.54	460'	24
	6"	6.625	6.065	.280	180	369.00	400'	20
	8"	8.625	7.962	332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 80 Pressure Pipe Available in Plain end only	1/2"	.840	.546	.147	850	20.50	12000'	28
	3/4"	1.050	.742	.154	690	27.80	8100'	28
	1"	1.315	.957	.179	630	40.90	6300'	28
	1¼"	1.660	1.278	.191	520	56.70	3920'	28
	1½"	1.900	1.500	.200	470	68.60	3020'	28
	2"	2.375	1.939	.218	400	94.90	2100'	28
	2½"	2.875	2.323	.276	420	144.90	1460'	28
	3"	3.500	2.900	.300	370	193.80	920'	28
	4"	4.500	3.826	.337	320	283.30	580'	28
	5"	5.563	4.813	.375	290	396.45	460'	24
	6"	6.625	5.761	.432	280	544.64	400'	20
	8"	8.625	7.625	.500	250	827.00	280'	16

Available in 20' lengths only. Available in white or gray. 8" in gray only.

Eagle PVC Schedule 40 and Schedule 80 meets all the requirements of ASTM D1785 and D1784 and is listed by NSF International for potable water.

Eagle PVC Schedule 40 and Schedule 80 is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts. PVC Schedule 40 **Not** recommended for threading. PVC Schedule 80 is suitable for threading; however, pressure ratings listed above are reduced by 50% when pipe is threaded.

NOTE: INSTALLATION OF PVC SCHEDULE 80 PIPE REQUIRES SPECIAL JOINING PROCEDURES AND SOLVENT CEMENTS. (See Paragraph #9 on reverse side.)

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

SUBMITTAL REVIEW
Review is only for general conformance with the design concept and limited to requirements called for in the contract documents. Sub-contractor is responsible for the accuracy of dimensions, quantities and details requiring confirmation ... the techniques of fabrication or construction ...
X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected
Date 6/21/93 Department EWG
By D.N.

SPECIFICATION SHEET
Effective June 1, 1992

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 22-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
	1¼"	1.660	1.532	.064	160	22.00	3920'	28
EAGLE	G 1½"	1.900	1.754	.073	160	28.90	3020'	28
PVC	G 2"	2.375	2.193	.091	160	43.00	2100'	28
160 PSI	G 2½"	2.875	2.655	.110	160	63.30	1460'	28
Pressure Pipe	G 3"	3.500	3.230	.135	160	92.30	920'	28
SDR 26	G 4"	4.500	4.154	.173	160	155.90	580'	28
Available in BOE	5"	5.563	5.135	.214	160	238.83	460'	24
	G 6"	6.625	6.115	.255	160	338.15	400'	20
	G 8"	8.625	7.962	.332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

SIZES MARKED WITH "G" AVAILABLE WITH MOLDED IN PLACE GASKET
WHEN ORDERING GASKETED PIPE, PLEASE SPECIFY "GASKETED".

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
	1/2"**	.840	.716	.062	315	10.60	12000'	28
	3/4"	1.050	.930	.060	200	13.00	8100'	28
	1"	1.315	1.189	.063	200	17.00	6300'	28
EAGLE	1¼"	1.660	1.502	.079	200	26.80	3920'	28
PVC	G 1½"	1.900	1.720	.090	200	34.50	3020'	28
200 PSI	G 2"	2.375	2.149	.113	200	52.00	2100'	28
Pressure Pipe	G 2½"	2.875	2.601	.137	200	76.80	1460'	28
SDR 21	G 3"	3.500	3.166	.167	200	112.70	920'	28
Available in BOE	G 4"	4.500	4.072	.214	200	190.45	580'	28
	5"	5.563	5.033	.265	200	291.41	460'	24
**½" SDR 13.5	G 6"	6.625	5.993	.316	200	413.69	400'	20
	G 8"	8.625	7.804	.411	200	705.15	280'	16

Eagle PVC meets all the requirements of ASTM D2241 and D1784 and is listed by NSF International for potable water.

Eagle PVC is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts.

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Warranty for Piping

METERS

Manual No. 920685-8

Great Plains Industries, Inc. Limited Warranty Policy

Great Plains Industries, Inc., 5252 East 36th Street North, Wichita, Kansas 67220-3205, hereby provides a limited one year warranty against defects in material and workmanship on all products manufactured by Great Plains Industries, Inc. This warranty shall extend to the purchaser of this product and to any person to whom such product is transferred during the warranty period.

The warranty period shall begin on the date of the original new equipment purchase. Warrantor's obligation hereunder shall be limited to repairing defective workmanship or replacing or repairing any defective part or parts. This warranty shall not apply if:

a.) the product has been altered or modified outside the warrantor's duly appointed representative;

b.) the product has been subjected to neglect, misuse, abuse or damage or has been installed or operated other than in accordance with the manufacturer's operating instructions.

To make a claim against this warranty, notice of claim must be given in writing to the company at its above address no later than 30 days after the expiration of the warranty period. Such notice shall identify the defect in the product. The company shall, within 14 days of receipt of such notice, notify the customer to either send the product, transportation prepaid, to the company at its office in Wichita, Kansas, or to a duly authorized service center. The company shall perform all obligations imposed on it by the terms of this warranty within 60 days of receipt of the defective product.

GREAT PLAINS INDUSTRIES, INC. EXCLUDES LIABILITY UNDER THIS WARRANTY FOR DIRECT, INDIRECT, INCIDENTAL AND CONSEQUENTIAL DAMAGES INCURRED IN THE USE OR LOSS OF USE OF THE PRODUCT WARRANTED HEREUNDER.

The company herewith expressly disclaims any warranty of merchantability or fitness for any particular purpose other than for which it was designed.

This warranty gives you specific rights and you may also have other rights which vary from U.S. state to U.S. state.

NOTE: In compliance with MAGNUSON MOSS CONSUMER WARRANTY ACT - Part 702 (governs the resale availability of the warranty terms).

GPI®

5252 East 36th Street North
Wichita, KS USA 67220-3205
TEL: 316-686-7361
FAX: 316-686-6746

GREAT PLAINS INDUSTRIES, INC.

1-888-996-3837
www.gplains.com/gpi

CHECK VALVES

FREIGHT TERMS: All shipments are F.O.B. shipping point. Shipments from factory less than 1000 lbs. are F.O.B. factory. Factory shipments OF $5000 and over within the continental U.S.A. will be prepaid and allowed when made at the lowest motor carrier transportation rate.

See page 3 for the advantages of buying the whole Watts line.

PAYMENT TERMS: The invoices are due and payable 30 days from the date of invoice. A 2% cash discount allowed on net amount of invoice if paid on or before the 10th of the following month. Invoices dated on or after the 25th will be considered as dated the first of the next month. Postmark on envelope will be considered date of check.

PURCHASE ORDER FORMS: Orders submitted on customer's own purchase order forms will be accepted only with the express understanding that no statements, clauses, or conditions contained in said order form will be binding on the Seller if they in any way modify the Seller's own terms and conditions of sales.

STOCKING WHOLESALER MINIMUM CHARGE: A minimum billing charge of $100.00 applies to shipments F.O.B. factory. Stocking Wholesaler Customers are encouraged to order sufficient material to avoid this charge which is necessitated by increased costs of processing small orders.

SPECIAL PRODUCTS: Orders for special or modified products are non-cancelable.

LIMITED WARRANTY: Watts Regulator Company warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge. This shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the product. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Any implied warranties that are imposed by law are limited in duration to one year.

Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights.

SERVICE POLICY: For inoperative products beyond the warranty period, we assume no liability for replacement of valves due to service conditions beyond our control.

RETURNED GOODS MINIMUM CHARGE: No material shall be returned without authorization. When credit is issued it will be at the price charged, or prevailing price if lower, less handling charges based on costs of reconditioning, boxing, etc. However, a minimum 15% handling charge will apply. A minimum handling charge of $10.00 is applied whenever the 15% handling deduction does not total $10.00. Products which are obsolete or made to special order are not returnable.

NOTE: Prices and terms are subject to change without notice and supersede all previous quotations. The right is reserved to change or modify product design or construction without prior notice and without incurring any obligation to make such changes and modifications on products previously or subsequently sold.

PRESS. GAUGES

GENERAL INFORMATION

PRODUCT

VALLEY INSTRUMENT is an industrial instrument manufacturer serving the needs of domestic and international customers for over 50 years. Our products include pressure gauges from 1.5" to 6", with capabilities in pressure from low pressure applications - inches of water, to high pressure applications - 20,000 PSI and bi-metal thermometers from 1" to 5" with temperature ranges up to 1000° F.

Custom pressure gauges are available with special calibration, custom logo's, special pressure ranges, unique color coding or any other special feature the customer may require.

PRESSURE:

When choosing a pressure range you should choose one that is twice the normal system pressure. EXAMPLE: If system runs at 50 PSI you should choose a 100 PSI gauge. This will make the gauge last longer and will be more afe and accurate

MEDIUM:

Consult the gauge selection guide for medium compatibility.

ENVIRONMENT:

Special consideration should be given in corrosive atmospheres such as chemical, salt air, water or dust. VALLEY INSTRUMENT can offer many styles that ward off these corrosive attacks.

LIQUID FILLING:

This feature adds to the life of a pressure gauge. When the case is filled with a dampening fluid, the internal components are protected from outside contaminants, providing continuous lubrication for the tube and movement, reducing the shock waves caused by vibration or pressure fluctuations, and virtually eliminating pointer flutter. It should not be used in conjunction with oxygen service or other explosive agents.

WARNING:

Misuse of this product may cause explosion and personal injury.

Liquid filled gauges should not be used in applications involving oxygen, chlorine, nitric acid, hydrogen peroxide, and other strong oxidizing agents, because of the danger of spontaneous chemical reaction, ignition, or explosion.

WARRANTY:

This warranty is in lieu of all other warranties expressed or implied. VALLEY INSTRUMENT warrants that all products sold shall be free from defects in workmanship and material when used within the service and scope for which they were designed. Such warranty shall apply for a period of one year after the shipment of the product. If at any time within this period, it is established to the satisfaction of VALLEY INSTRUMENT that the product was defective at time of shipment, VALLEY INSTRUMENT at its option, shall furnish replacements of , or repair the product. It is understood that the liability of VALLEY INSTRUMENT shall be limited to such repair or replacement and that VALLEY INSTRUMENT shall not be liable for any direct or consequential damages arising out of any defects or from any cause whatsoever. This warranty does not cover deterioration by normal wear and tear or any other cause of failure other than defects in workmanship and material as previously outlined. Unless repairs to, alterations of, or work done on the product by the purchaser is specifically authorized in writing by VALLEY INSTRUMENT, any warranty applicable to the product shall become null and void.

RETURNED GOODS:

VALLEY INSTRUMENT will make every effort possible to rectify errors which result in items being returned for credit. VALLEY INSTRUMENT requires a return authorization number and a copy of the packing list with all returned goods, a rehandling charge may apply. Our goal is to provide you with prompt and correct credit. Special order products may not be returned.

SPECIFICATIONS:

The design specifications found in this catalog are subject to change without notice.

350 SERIES BACKWASH VALVES

MODEL	DESCRIPTION	PRICE
350-22-A-XX Hydraulic	2" X 2" Backwash Valve	$180
350-55-22-A-XX Electric Remote	2" X 2" Backwash Valve	320
350-32-A-XX Hydraulic	3" X 2" Backwash Valve	380
350-55-32-A-XX Electric Remote	3" X 2" Backwash Valve	520
350-43-XX Hydraulic	4" X 3" Backwash Valve	760
350-55-43-A-XX Electric Remote	4" X 3" Backwash Valve	900

XX = 12- Flanged Class 125; GR-Grooved; NP-Threaded

1" BERMADON

MODEL	DESCRIPTION	PRICE
MT	FLOW 2.5 - 22 GPM	$70
Dial Capacity: 300; 550; 1,200; 2,600; 5,500; 13,000 Gal.		
MTA	FLOW .5 - 9 GPM	70
Dial Capacity: 125; 500; 1,200; 2,000 Gal.		

900 SERIES HYDROMETER WATER METER AND CONTROL VALVE

MODEL	BASIC MODELS	1 1/2"	2"	3"	4"	6"	8"
900	Water Meter Basic Control Valve-Included	$415	$460	$820	$1,450	$2,600	$3,725
910	Water Meter & Control Valve Electric Remote Control	530	590	990	1,665	2,810	3,945
920	Water Meter & Pressure Reducing Valve	610	680	1075	1,745	3,050	4,185
930	Water Meter & Pressure Sustaining/Relief Valve	610	680	1075	1,745	3,050	4,185
923	Water Meter with Pressure Reducing & Sustaining Valve	770	855	1,255	1,925	3,580	4,700

900 SERIES–OPTIONS AND ACCESSORIES

WATER METER	XX-P	Electric Pulse Transmission 1 1/2"-4" 1 pulse/.1 gal or /1 or /10 gal or /100 gal 6"-8" 1 pulse/1 gal or /10 gal or /100 gal or /1,000 gal	110
	XX-D	Pre-Set Quantity Valve Shut-Off (3-Way Pilot Valve) **Dial Selection 1 1/2", 2", 3":** 13,000/50,000/130,000/210,000, **3"-8":** 130,000/210,000/500,000/870,000/1,300,000	90
	XX-DD	Hydraulic Sequential Operation (5-Way Pilot Valve)	110
	XX-S	Pre-Set Quantity Pump Shut-Off (Electric Switch)	250
CONTROL VALVE	XX-20	Check Feature	80
	XX-30	Two Stage Opening	140
	XX-55	Electric Remote Control (Included in Model 910)	185
	XX-Z	Manual Control - (Manual Select Valve-On/Off/Auto)	40
	XX-F	Large Control Filter	290
	XX-CT	Copper Tubing/Brass Fittings	125

Consult factory for other available control functions.

AIR RELEASE VALVE

BERMAD

ontrol Valves

4070 East Leaverton Court
Anaheim, California 92807
(714) 666-1100

1-800-821-6825
FAX (714) 666-2533
e-mail; bermad@bermadusa.com

Prices are F.O.B. Anaheim, California. Prices are subject to change without notice. A minimum order charge of $50.00 NET applies to all orders. Payment terms are NET THIRTY (30) DAYS.

TERMS OF SALE
No material shall be returned without prior written authorization from the factory. Merchandise returned for credit must be received in new unused condition and return freight must be prepaid. A 20% restocking charge will apply.

LIMITED WARRANTY:
Bermad, Inc. warrants each product against defects in material and workmanship for a period of one year from the date of original shipment when installed and operated according to Bermad, Inc. instructions. Defective materials will be repaired or replaced free of charge when returned to our factory freight prepaid provided Bermad, Inc. receives prompt written notice of the claimed defect. Bermad, Inc. shall not be liable for any incidental or consequential damage loss or expense arising directly or indirectly from the use of the product.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

GATE VALVES

NIBCO INC. 125% LIMITED WARRANTY

Applicable to NIBCO INC. Pressure Rated Metal Valves

NIBCO INC. warrants each NIBCO pressure rated metal valve to be free from defects in materials and workmanship under normal use and service for a period the lesser of one (1) year from the date put in service, or two (2) years from the date of purchase.

In the event any defect occurs which the owner believes is covered by this warranty, the owner should immediately contact NIBCO Technical Services, either in writing or by telephone at (888) 446-4226 or (574) 295-3000. The owner will be instructed to return said product, at the owner's expense, to NIBCO INC., or an authorized representative for inspection. In the event said inspection discloses to NIBCO INC.'s satisfaction that said valve is defective, it will be replaced at NIBCO INC.'s expense. Replacements shall be shipped free of charge to the owner. In the event of the replacement of any valve, NIBCO INC. shall further pay the owner the greater of Twenty-Five (25%) Percent of the price of the valve according to NIBCO INC.'s published suggested list price schedule in effect at the time of purchase, or Ten ($10.00) Dollars, to apply on the cost of the installation of said replacement valve.

TO THE EXTENT PERMITTED BY LAW, THIS WARRANTY SPECIFICALLY EXCLUDES INCIDENTAL AND CONSEQUENTIAL DAMAGES OF EVERY TYPE AND DESCRIPTION RESULTING FROM ANY CLAIMED DEFECT IN MATERIAL OR WORKMANSHIP, INCLUDING BUT NOT LIMITED TO, PERSONAL INJURIES AND PROPERTY DAMAGES. Some states do not allow the exclusion or limitation of incidental or consequential damages so these limitations may not apply to you. TO THE EXTENT PERMITTED BY LAW, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED IN DURATION.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

NIBCO INC. World Headquarters •1516 Middlebury St. • Elkhart, IN 46516-4740 USA • *www.nibco.com*

how to order

State quantity, figure number and size for each valve you wish to order. See individual valve catalog pages for specific or special product designations.

HOW MANY TO ORDER

NIBCO valves are decimal packed for your convenience in handling, shipping and stock-keeping. Number in master carton varies with item.

POLICY ON RETURNS TO FACTORY

NO NIBCO valves are to be returned without prior written agreement. Transportation must be prepaid. A 20% charge will be made to cover cost of rehandling and reinspection.

TECHNICAL ASSISTANCE

Engineers, contractors, wholesalers or manufacturers may obtain special or technical assistance from any factory representative of NIBCO. Write, fax or phone.

NIBCO INC.
World Headquarters
1516 Middlebury Street
Elkhart, IN 46516-4740
USA

Phone: 1.574.295.3000
Fax: 1.574.295.3307
Technical Service Phone: 1.888.446.4226
Fax: 1.888.336.4226

PVC SCHEDULE 80 FITTINGS, UNIONS, CLASS 150 FLANGES & TANK ADAPTERS

SPEARS QUALITY POLICY

It is the policy and objective of Spears Manufacturing Company to produce a superior quality product suitable for its intended use, with regard to functionality, structural integrity, and conformance to established industry standards and practices. It is the commitment of this Company to do so in a manner which provides consistency of product quality, optimum availability, and superior customer service, while maintaining efficiency of operations and profitability necessary to perpetuate product improvement and customer satisfaction. Furthermore, it is recognized that the attainment of these objectives is the responsibility of all Company operations and personnel according to their respective functions.

LIMITED WARRANTY

Except as otherwise mandated by law, Spears Manufacturing Company warrants that the goods which have been directly manufactured by them shall be free from defects in material and workmanship for a period of one (1) year, from the date of shipment. CUSTOMER AGREES THAT THIS WARRANTY SHALL BE EFFECTIVE SO LONG AS THE GOODS ARE USED SOLELY FOR THE NORMAL PURPOSES FOR WHICH THEY ARE INTENDED AND IN CONFORMANCE WITH INDUSTRY ESTABLISHED ENGINEERING, INSTALLATION, OPERATING, AND MAINTENANCE SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS. VIOLATION THEREOF SHALL VOID THIS WARRANTY AND RELIEVE COMPANY FROM ANY OBLIGATION UNDER THIS WARRANTY. COMPANY CANNOT AND DOES NOT ASSUME RESPONSIBILITY, AND EXPRESSLY DISCLAIMS ANY LIABILITY, DUE TO CUSTOMER'S, ANY INSTALLER'S OR END USER'S FAILURE TO COMPLY WITH SUCH SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS.

If Customer receives any goods that appear to be defective, upon receipt of a Return Authorization (RA#) issued by Spears Customer Services Department, Customer may return such questionable goods. The material must be returned prepaid to Company at 15853 Olden Street, Sylmar, California 91342 along with completed Return Authorization documentation. After examination if the goods are determined to be defective in materials or workmanship directly provided by Company, Company, at its sole option, may either repair or replace the defective goods, or reimburse Customer for the cost of such goods. This shall be Customer's only remedy. All costs of shipping such questionable goods and any replacements thereof to and from Company's facility shall be borne by Customer. Customer agrees that Company will not be responsible for other parts or labor in connection with repairing, replacing, or returning such goods while goods are in possession of Company for analysis, nor for any delays beyond Company's reasonable control (including, with limitation, delays due to unavailability of materials, equipment, other supplies or labor, strikes, governmental regulation or other acts of God), provided that any delay shall toll the warranty period for the same amount of time as the delay itself.

COMPANY EXTENDS ONLY THIS WARRANTY AND EXPLICITLY WAIVES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ORAL OR STATUTORY (INCLUDING ANY IMPLIED WARRANTIES OR AFFIRMATION, SUITABILITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) APPLICABLE TO THE GOODS. NO AFFIRMATION BY COMPANY OR ANY OF ITS REPRESENTATIVES, BY WORDS OR CONDUCT, SHALL CONSTITUTE A WARRANTY. THIS WARRANTY MAY NOT BE EXTENDED, ALTERED OR OTHERWISE MODIFIED EXCEPT BY WRITTEN AGREEMENT SIGNED BY COMPANY.

BY ITS ACCEPTANCE OF THE GOODS, CUSTOMER HEREBY SPECIFICALLY AND EXPRESSLY WAIVES ALL OTHER LIABILITY OR OBLIGATION OF ANY KIND OR CHARACTER OF COMPANY, INCLUDING WITHOUT LIMITATION LIABILITY PREDICATED UPON STRICT LIABILITY OR TORT, AND ALL DAMAGES AND LOSSES AS A RESULT THEREOF, INCLUDING BUT NOT LIMITED TO ALL KNOWN, UNKNOWN, FORESEEABLE, UNFORESEEABLE, ABSOLUTE, CONTINGENT, LIQUIDATED, NON-LIQUIDATED, COMPENSATORY, GENERAL, SPECIAL, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES, AND WITH RESPECT TO THE GOODS, THEIR RETURN; REPAIR, RESTORATION AND REPLACEMENT. WITH RESPECT TO SUCH WAIVER, CUSTOMER HEREBY EXPLICITLY WAIVES CALIFORNIA CIVIL CODE §1542 WHICH STATES "A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS FAVOR AT THE TIME OF EXECUTING THIS RELEASE, WHICH IF KNOWN BY HIM MUST HAVE MATERIALLY ADVERSELY AFFECTED HIS SETTLEMENT WITH DEBTOR" AND ALL OTHER SIMILAR STATUTORY, COMMON AND CASE LAW RIGHTS, DEFENSES AND LIMITATIONS.

Having independently inspected a sample of the goods as fully as desired or having refused to make such examination upon acceptance of delivery of the goods, and except as otherwise herein provided, Customer hereby accepts the goods in its "AS IS" condition "WITH ALL FAULTS" without any other warranty, expressed or implied, and hereby accepts and assumes the entire risk and cost of all necessary servicing, repairs and remedy thereof.

STANDARDS & SPECIFICATIONS

Standards provide greater assurance of product performance and consistency, and are available to assist design engineers in system specification. The most frequently referenced industry standards for plastic piping systems are ASTM Standard Specifications and Practices. Along with ASTM Standards, additional product specifications and certifications form the basis of product conformance to which Spears products are manufactured.

ASTM D 2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
NSF	National Sanitation Foundation (NSF) Standard 61 and/or 14 Plastic Fittings for Potable Water.
Material	Spears Schedule 80 Fittings are produced from PVC Cell Classification 12454.
Fabricated Fittings	Spears Fabricated Fittings conform to Spears Manufacturing Company Special Engineering Specifications.

Prices subject to change without notice. Possession of this price schedule shall not be construed as an offer to sell the products listed. Product drawings and/or photographs are representative and may not fully reflect product configurations.

Made in the U.S.A.

PVC WHITE SCHEDULE 40 FITTINGS, UNIONS AND SADDLES

SPEARS QUALITY POLICY

It is the policy and objective of Spears Manufacturing Company to produce a superior quality product suitable for its intended use, with regard to functionality, structural integrity, and conformance to established industry standards and practices. It is the commitment of this Company to do so in a manner which provides consistency of product quality, optimum availability, and superior customer service, while maintaining efficiency of operations and profitability necessary to perpetuate product improvement and customer satisfaction. Furthermore, it is recognized that the attainment of these objectives is the responsibility of all Company operations and personnel according to their respective functions.

LIMITED WARRANTY

Except as otherwise mandated by law, Spears Manufacturing Company warrants that the goods which have been directly manufactured by them shall be free from defects in material and workmanship for a period of one (1) year, from the date of shipment. CUSTOMER AGREES THAT THIS WARRANTY SHALL BE EFFECTIVE SO LONG AS THE GOODS ARE USED SOLELY FOR THE NORMAL PURPOSES FOR WHICH THEY ARE INTENDED AND IN CONFORMANCE WITH INDUSTRY ESTABLISHED ENGINEERING, INSTALLATION, OPERATING, AND MAINTENANCE SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS. VIOLATION THEREOF SHALL VOID THIS WARRANTY AND RELIEVE COMPANY FROM ANY OBLIGATION UNDER THIS WARRANTY. COMPANY CANNOT AND DOES NOT ASSUME RESPONSIBILITY, AND EXPRESSLY DISCLAIMS ANY LIABILITY, DUE TO CUSTOMER'S, ANY INSTALLER'S OR END USER'S FAILURE TO COMPLY WITH SUCH SPECIFICATIONS, RECOMMENDATIONS AND INSTRUCTIONS.

If Customer receives any goods that appear to be defective, upon receipt of a Return Authorization (RA#) issued by Spears Customer Services Department, Customer may return such questionable goods. The material must be returned prepaid to Company at 15853 Olden Street, Sylmar, California 91342 along with completed Return Authorization documentation. After examination if the goods are determined to be defective in materials or workmanship directly provided by Company, Company, at its sole option, may either repair or replace the defective goods, or reimburse Customer for the cost of such goods. This shall be Customer's only remedy. All costs of shipping such questionable goods and any replacements thereof to and from Company's facility shall be borne by Customer. Customer agrees that Company will not be responsible for other parts or labor in connection with repairing, replacing, or returning such goods while goods are in possession of Company for analysis, nor for any delays beyond Company's reasonable control (including, with limitation, delays due to unavailability of materials, equipment, other supplies or labor, strikes, governmental regulation or other acts of God), provided that any delay shall toll the warranty period for the same amount of time as the delay itself.

COMPANY EXTENDS ONLY THIS WARRANTY AND EXPLICITLY WAIVES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ORAL OR STATUTORY (INCLUDING ANY IMPLIED WARRANTIES OR AFFIRMATION, SUITABILITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) APPLICABLE TO THE GOODS. NO AFFIRMATION BY COMPANY OR ANY OF ITS REPRESENTATIVES, BY WORDS OR CONDUCT, SHALL CONSTITUTE A WARRANTY. THIS WARRANTY MAY NOT BE EXTENDED, ALTERED OR OTHERWISE MODIFIED EXCEPT BY WRITTEN AGREEMENT SIGNED BY COMPANY.

BY ITS ACCEPTANCE OF THE GOODS, CUSTOMER HEREBY SPECIFICALLY AND EXPRESSLY WAIVES ALL OTHER LIABILITY OR OBLIGATION OF ANY KIND OR CHARACTER OF COMPANY, INCLUDING WITHOUT LIMITATION LIABILITY PREDICATED UPON STRICT LIABILITY OR TORT, AND ALL DAMAGES AND LOSSES AS A RESULT THEREOF, INCLUDING BUT NOT LIMITED TO ALL KNOWN, UNKNOWN, FORESEEABLE, UNFORESEEABLE, ABSOLUTE, CONTINGENT, LIQUIDATED, NON-LIQUIDATED, COMPENSATORY, GENERAL, SPECIAL, CONSEQUENTIAL, INCIDENTAL, OR PUNITIVE DAMAGES, AND WITH RESPECT TO THE GOODS, THEIR RETURN, REPAIR, RESTORATION AND REPLACEMENT. WITH RESPECT TO SUCH WAIVER, CUSTOMER HEREBY EXPLICITLY WAIVES CALIFORNIA CIVIL CODE §1542 WHICH STATES "A GENERAL RELEASE DOES NOT EXTEND TO CLAIMS WHICH THE CREDITOR DOES NOT KNOW OR SUSPECT TO EXIST IN HIS FAVOR AT THE TIME OF EXECUTING THIS RELEASE, WHICH IF KNOWN BY HIM MUST HAVE MATERIALLY ADVERSELY AFFECTED HIS SETTLEMENT WITH DEBTOR" AND ALL OTHER SIMILAR STATUTORY, COMMON AND CASE LAW RIGHTS, DEFENSES AND LIMITATIONS.

Having independently inspected a sample of the goods as fully as desired or having refused to make such examination upon acceptance of delivery of the goods, and except as otherwise herein provided, Customer hereby accepts the goods in its "AS IS" condition "WITH ALL FAULTS" without any other warranty, expressed or implied, and hereby accepts and assumes the entire risk and cost of all necessary servicing, repairs and remedy thereof.

STANDARDS & SPECIFICATIONS

Standards provide greater assurance of product performance and consistency, and are available to assist design engineers in system specification. The most frequently referenced industry standards for plastic piping systems are ASTM Standard Specifications and Practices. Along with ASTM Standards, additional product specifications and certifications form the basis of product conformance to which Spears products are manufactured.

ASTM D 2466	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
ASTM D 2609	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
NSF	National Sanitation Foundation (NSF) Standard 61 and/or 14 Plastic Fittings for Potable Water.
Material	Spears Schedule 40 Fittings are produced from PVC Type I, Cell Classification 12454.
Fabricated Fittings	Spears Fabricated Fittings conform to Spears Manufacturing Company Special Engineering Specifications.

Prices subject to change without notice. Possession of this price schedule shall not be construed as an offer to sell the products listed. Product drawings and/or photographs are representative and may not fully reflect product configurations.

Made in the U.S.A.

PVC PIPE

Warranty

This warranty covers all products sold by Eagle Plastics, Inc. which are not specifically covered by other product warranties. Eagle Plastics, Inc. warrants this product to be free from defects in material or workmanship for a period of one year from date of purchase. This warranty is in effect provided the proper installation and operating techniques have been employed and provided the product has not been subjected to misuse, negligence or abuse.

Eagle Plastics liability under this warranty is limited only to the replacement of pipe which is found to be defective. The defective pipe must be returned to Eagle Plastics, Inc. and all claims must be presented to Eagle in writing. This warranty does not cover the cost of installation for either the defective pipe or the replacement pipe furnished under the terms of this warranty.

As this is the only warranty applicable to this product, Eagle Plastics, Inc. does not authorize anyone to assume for it any other warranty.

A written notice of defect must be sent to Eagle Plastics, Inc., within a reasonable period of time after the defect becomes apparent. Written notice should be sent to: Eagle Plastics, Inc., P.O. Box 229, Hastings, NE 68901.

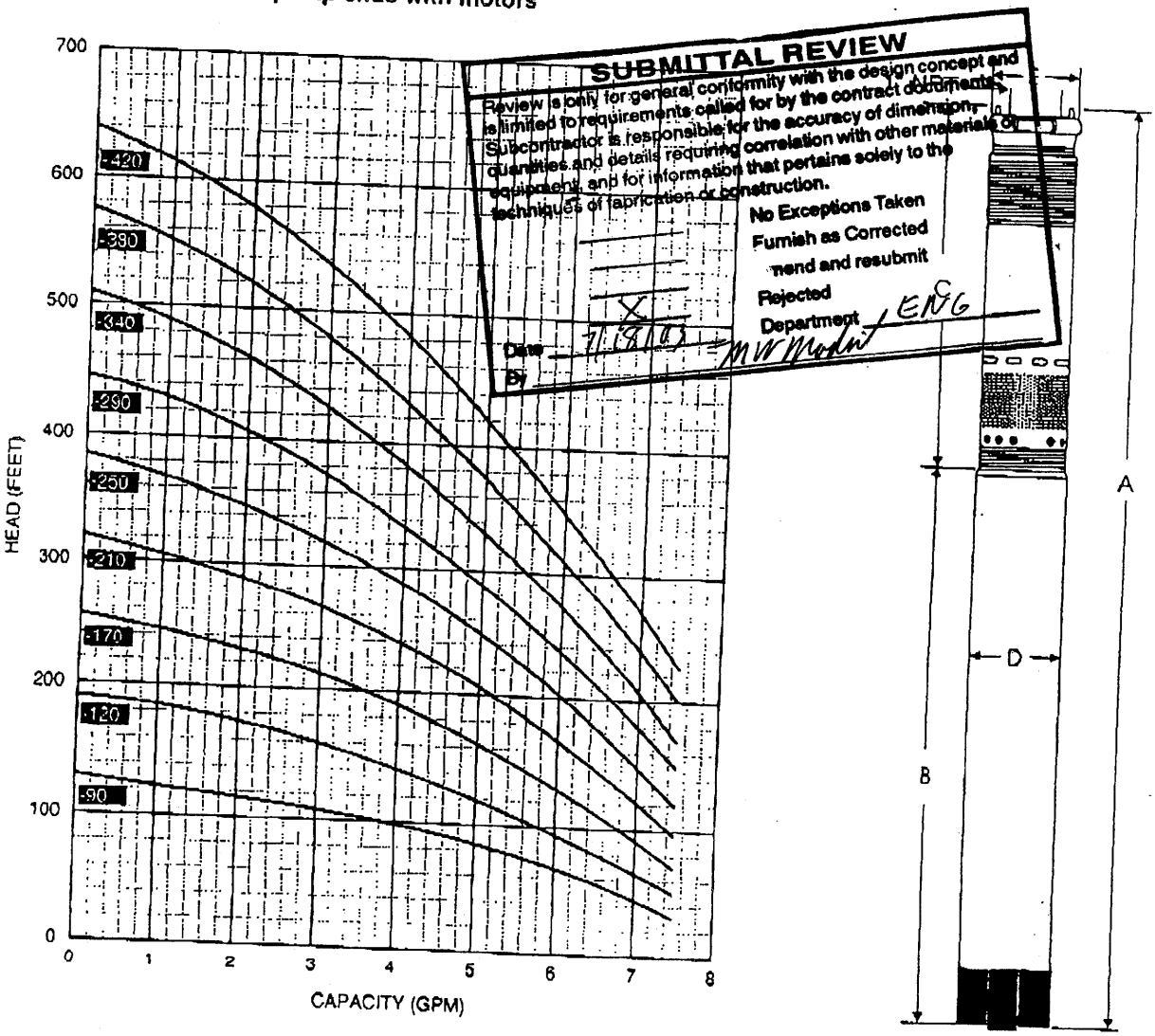
This warranty complies with the requirements of the Magnuson-Moss Warranty Act (the "ACT"), regulations of the Federal Trade Commission issued thereunder, and any applicable state or local laws, rules and regulations.

Eagle Plastics, Inc. shall not be liable for special or consequential damages or for damages resulting from negligence of others, misuse, casualties, acts of God or other matters beyond our control. The above limitation may not apply to you, as some states do not allow the limitation of special or consequential damages. This warranty gives you specific legal rights. You may have other rights which vary from state to state.

Descriptive Product Data for Each Pump

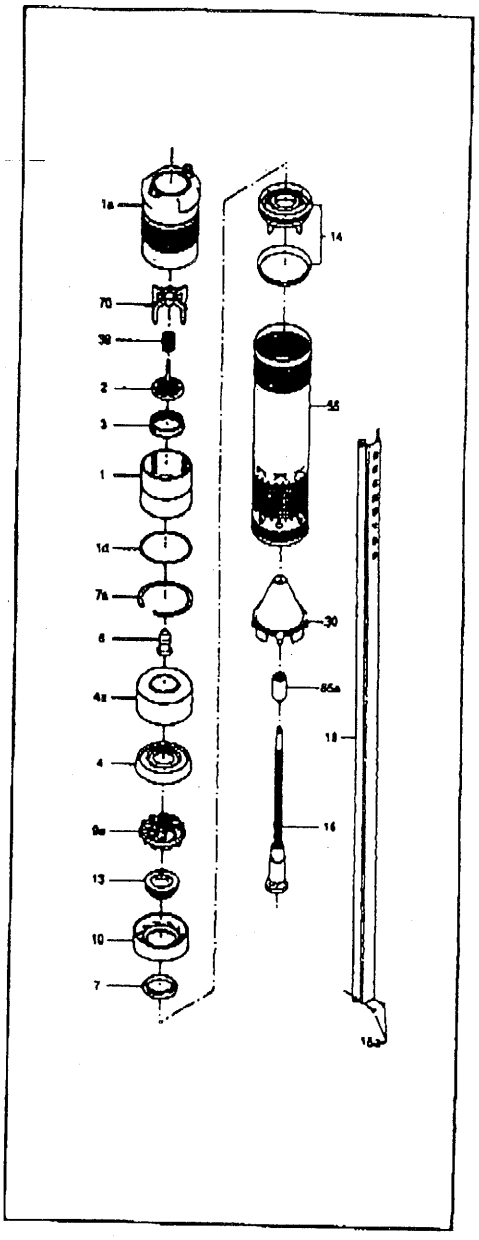
Model #	HP	Size	Disch. Size	Dimensions in Inches					Approx. Ship Wt.
				A	B	C	D	E	(pounds)
5Redi-Flo3-90	1/3A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5Redi-Flo3-120	1/3A	3"	1" NPT	30.4	19.8	10.6	2.6	2.9	12
5Redi-Flo3-170	1/2A	3"	1" NPT	31.5	19.8	11.6	2.6	2.9	12
5Redi-Flo3-210	1/2B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5Redi-Flo3-250	1/2B	3"	1" NPT	33.6	19.8	13.7	2.6	2.9	13
5Redi-Flo3-290	3/4B	3"	1" NPT	34.6	19.8	14.8	2.6	2.9	13
5Redi-Flo3-340	1C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5Redi-Flo3-380	1C	3"	1" NPT	38.2	21.3	16.9	2.6	2.9	16
5Redi-Flo3-420	1C	3"	1" NPT	39.3	21.3	18.0	2.6	2.9	16

Note: Weights include pump ends with motors



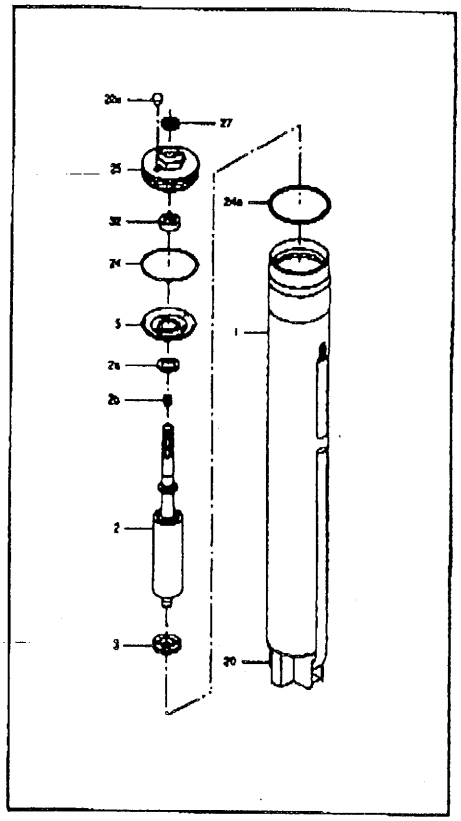
MATERIAL SPECIFICATION – REDI-FLO3 PUMP END

Pos.	Component	Material	DIN W. Nr.	AISI
1	Valve Casing	PVDF		
1a	Discharge Chamber	Stainless Steel	1.4401	316
1d	O-Ring	FPM Rubber		
2	Valve Cone	PVDF		
3	Valve Seat	FPM Rubber		
4	Top Chamber	PVDF		
4a	Empty Chamber	PVDF		
6	Top Bearing	FPM Rubber		
7	Neck Ring	PVDF		
7a	Lock Ring	Stainless Steel	1.4401	316
9a	Guide Vanes	PVDF		
10	Bottom Chamber	PVDF		
13	Impeller w/ tungsten carbide bearing	PVDF		
14	Suction Interconnector	PVDF		
14a	Ring	Stainless Steel	1.4401	316
16	Shaft w/ coupling	Stainless Steel	1.4401	316
		Sintered Steel		
18	Cable Guard	Stainless Steel	1.4401	316
18a	Cable Guard Screws	Stainless Steel	1.4401	316
30	Pressure Equalization Cone	PVDF		
39	Valve Spring	Stainless Steel	1.4406	316LN
55	Pump Sleeve	Stainless Steel	1.4401	316
70	Valve Guide	PVDF		
85a	Spacer	Stainless Steel	1.4401	316



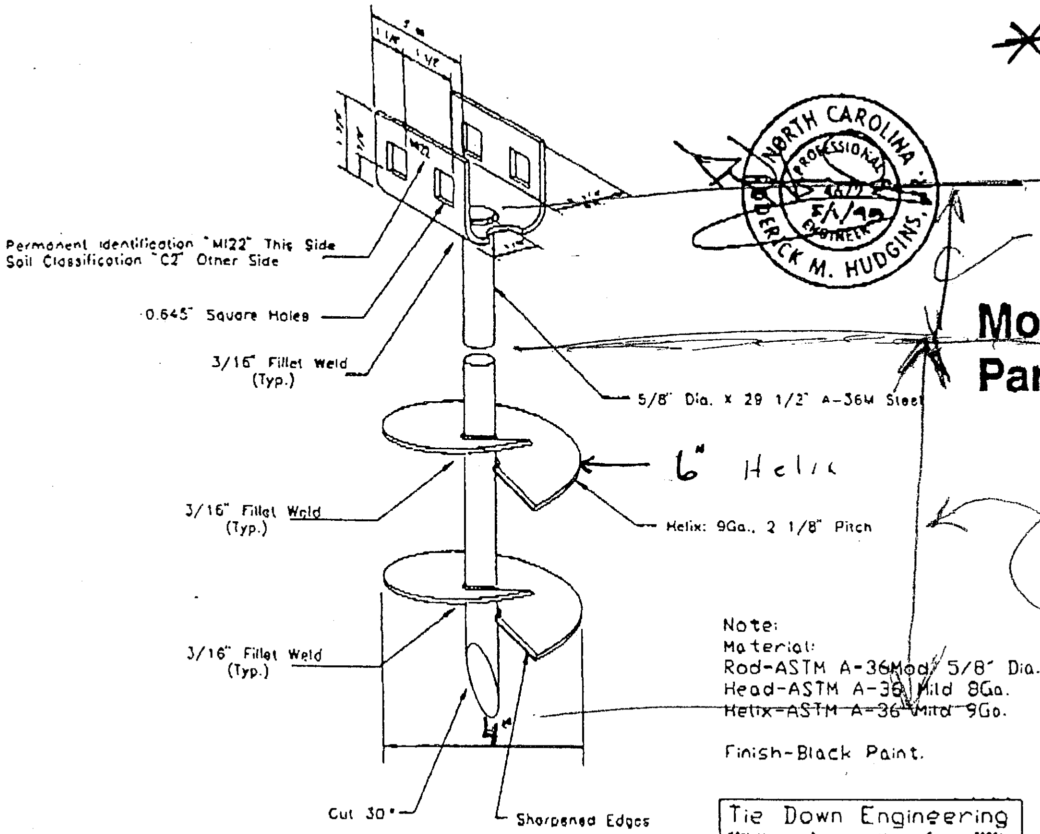
MATERIAL SPECIFICATION – REDI-FLO3 PUMP MOTOR

Pos.	Component	Material	DIN W. Nr.	AISI
1	Stator	Stainless Steel	1.4401	316
2	Rotor	Stainless Steel	1.4401	316
2a	Stop Ring	PP		
2b	Filter	Polyester		
3	Thrust Bearing	Carbon		
5	Radial Bearing	Ceramic/ tungsten carbide		
20	Motor Cable w/ plug	Tefzel		
		PVDF		
22a	Filling Plug	FPM Rubber		
24	O-Ring	FPM Rubber		
24a	O-Ring	FPM Rubber		
25	Top Cover	PPS		
27	Filter	Polyester		
32	Shaft Seal	FPM Rubber		
	Motor Liquid	SML-2		



ELECTRIC	
Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE 1x100-115V
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft-start
Run-up Time:	Maximum: 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF=1
Service Factor:	0.33-0.50A[Hp]-1.75 at 115V/230V 0.50-0.75B[Hp]-1.4 at 230V 1.0-1.5C[Hp]-1.15 at 230V
Motor Cable:	3 Wire, Tefzel Cable Kit
Motor Liquid:	Type SML 2
pH Values:	4-9
Liquid Temperature:	The temperature of the pumped liquid should not exceed 104°F.
Note: If liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Frost Protection:	If the pump is to be stored after use, it must be stored in a frost-free location or it must be ensured that the motor liquid is frost-proof. Otherwise motor must be stored without being filled with motor liquid.
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	-4°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE - NE 3):	
0.33-0.50A[Hp]	20.9" length x 2.68" diameter
0.50-0.75B[Hp]	20.9" length x 2.68" diameter
1.0-1.5C[Hp]	22.3" length x 2.68" diameter
Pump Diameter, incl. cable guard:	2.91"
Motor Weights (MSE - NE 3):	
0.33-0.50A[Hp]	6.0 lbs
0.50-0.75B[Hp]	7.1 lbs
1.0-1.5C[Hp]	8.2 lb
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions (min. and max.):	
5 Redi-Flo3	10.6" to 18.0"
10 Redi-Flo3	10.6" to 16.9"
15 Redi-Flo3	10.6" to 16.9"
22 Redi-Flo3	10.6" to 16.9"
30 Redi-Flo3	10.6" to 13.7"
Pump End Weights (min. and max.):	
All	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (maximum):	500 feet, below static water level

*



maintain sufficient clearance above Ground To accomodate Pile, Rope, and Bracket

Model MI225/8
Part # ~~59090~~
59250"

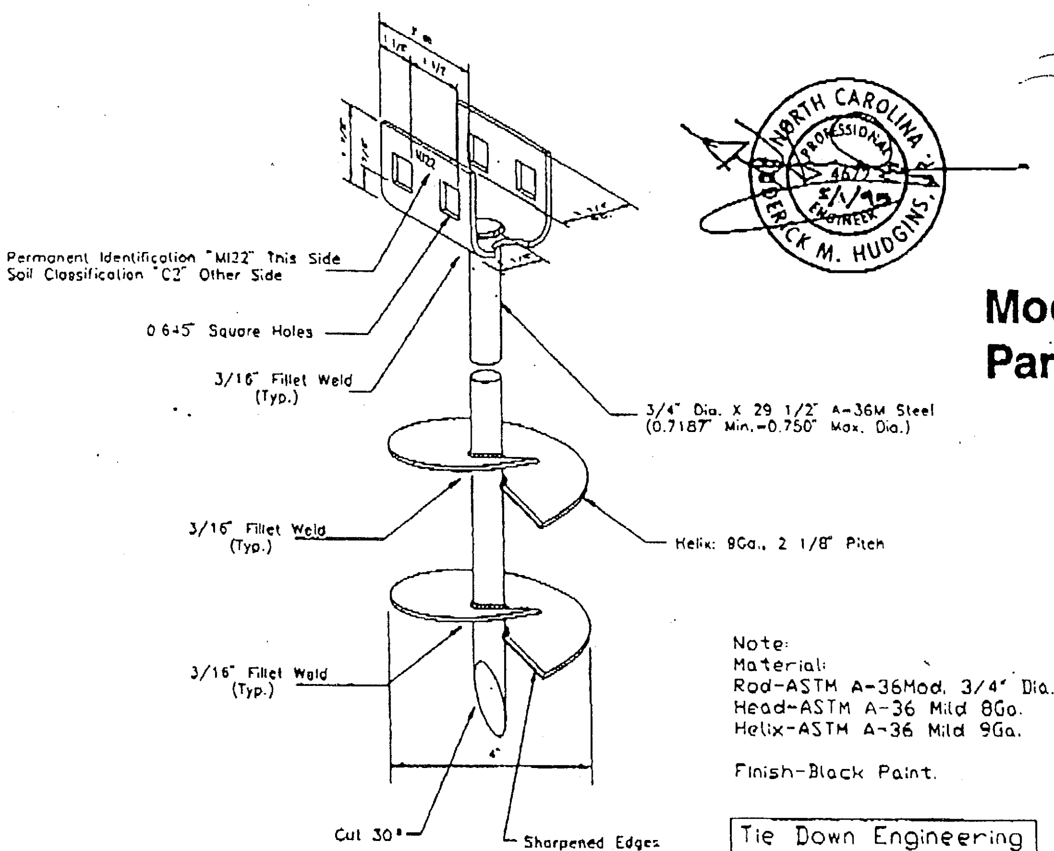
36" Length minimum

Note:
Material:
Rod-ASTM A-36Mod. 5/8" Dia.
Head-ASTM A-36 Mild 8Ga.
Helix-ASTM A-36 Mild 9Ga.

Finish-Black Paint.

40" Total per Addendum #4, and Adequate amount above Ground To facilite Attachment

Tie Down Engineering	
TITLE Model MI225/8, Double Helix Earth Anchor Part Number 59090	
SCALE None	DWG NO. 59090

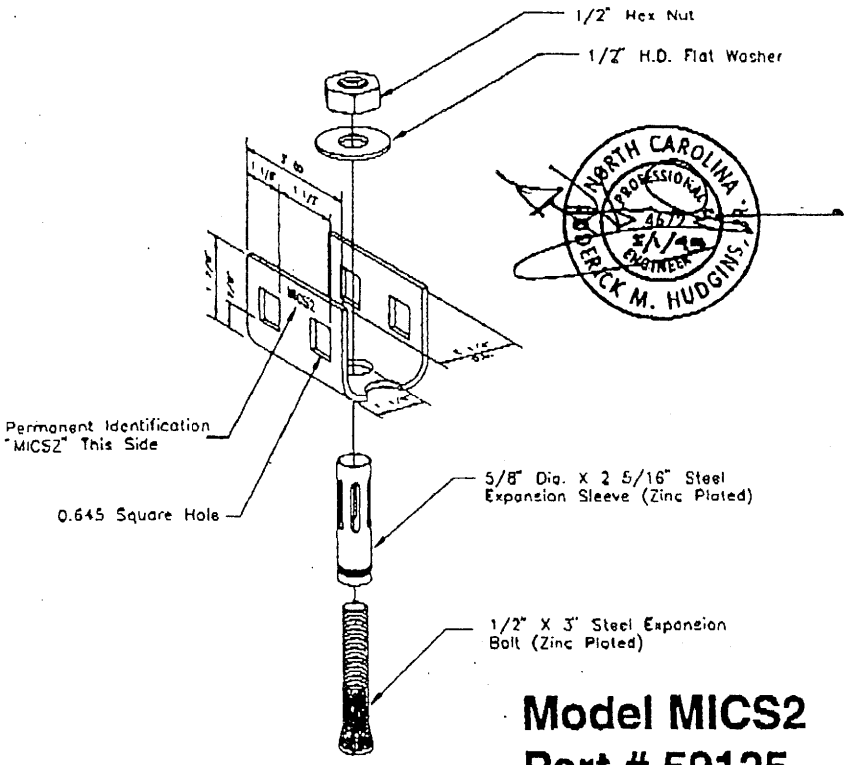


Model MI223/4
Part # 59095

Note:
Material:
Rod-ASTM A-36Mod. 3/4" Dia.
Head-ASTM A-36 Mild 8Ga.
Helix-ASTM A-36 Mild 9Ga.

Finish-Black Paint.

Tie Down Engineering	
TITLE Model MI223/4, Double Helix Earth Anchor Part Number 59095	
SCALE None	DWG NO. 59095



Model MICS2
Part # 59125

Installation Instructions

1. Drill 5/8" x 3" Hole In Slab.
2. Place Steel Expansion Sleeve Over Bolt & Place Into Hole.
3. Place Washer Over Tip Of Expansion Bolt.
4. Thread Nut Onto Expansion Bolt & Tighten Until Maximum Expansion Of Steel Expansion Sleeve Has Been Achieved.
5. Remove Nut & Washer.
6. Place MICS2 Head, Washer & Nut Over Tip Of Expansion Bolt & Tighten Nut.

Note:

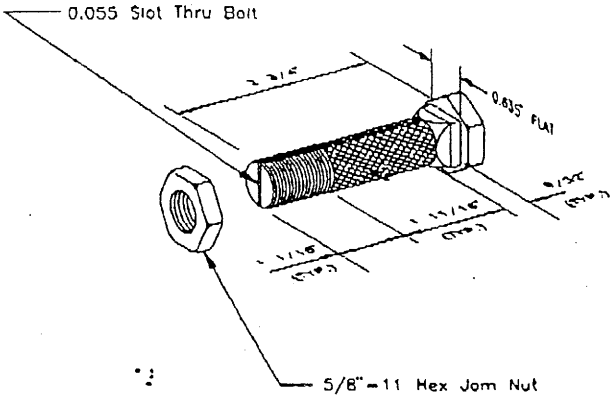
Concrete To Be 2500 PSI Min. Slab To Be 4" Min. Thickness With 6/6 x 10/10 Wire Mesh.

Concrete Slab Size To Allow 4750 LBS. Vertical Tension On Anchor Without Lifting Slab. Assume Concrete Wt. Of 150 LBS./CU. FT.

Note:
Material:
Head-ASTM A-36 Mild 8Ga.
Rod-ASTM A-36Mod.

Finish-Black Paint.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model MICS2-Metal Slab Anchor W/Expansion Bolt, Part Number 59125	
SCALE None	DWG. NO. 59125

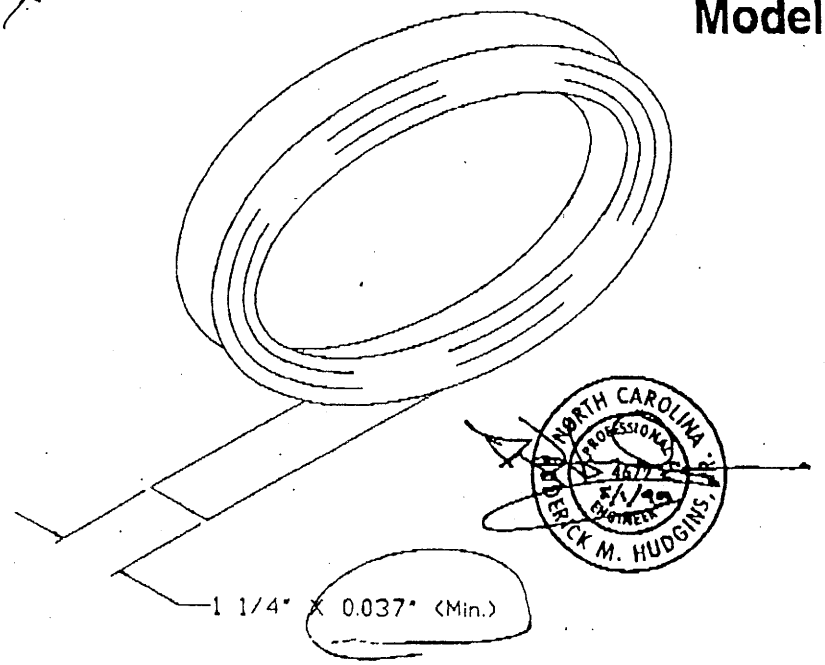


Model BISB
Part # 59135

Note:
Slotted Bolt Labeled TD On Head.
Made To ASTM A-307.
Hardness: SAE J429 GR-2
HRB 80-100 Degree.
Finish-Zinc Plated.

Tie Down Engineering	
5901 Wheaton Drive Atlanta, Georgia 30336	
TITLE Model BISB, Slotted Bolt Part Number 59135	
SCALE None	DWG. NO. 59135

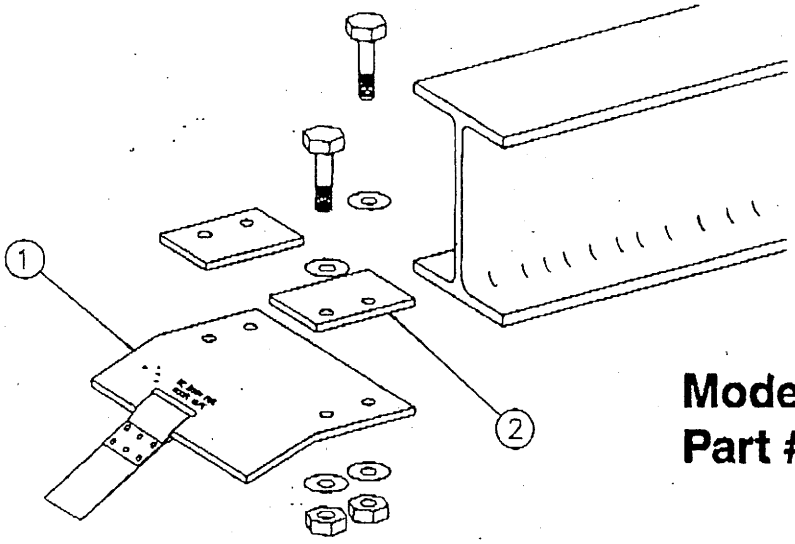
Model MH1000



Model No.	Length
MS33	33'
MS35	35'
MS37	37'
MS42	42'
MS60	60'
MS600	600'

Strap Marked Every 12"
TIE DOWN ENGINEERING
CERTIFIED TO ASTM D 3953-91
FED. SPEC. QQ-S781-H

Tie Down Engineering
Galvanized Strap
3-12-93
Drawing No. MH1000



Model MLFT
Part # 59188

Installation Instructions:
1. Install Bolts, Washers And Nuts Though End Frame Tie, Base (1) And Clips (2), As Shown.
2. Slide Assembly Over Lower Flange Of Trailer Beam. (Position Clips Above The Flange And The Base Plate Below)
3. Tighten The Fasteners To 25-30 FLLbs.
4. Attach The Strap To the appropiate Ground Anchor Following The Proper Installation Instructions.

Note:
Material:
End Frame Tie: AISI-C1008 8Ga.
Strap: ANSI A 225.1 (0.035" Min.)
1 1/4" x 7 Ft. Galvanized.
Strap Marked Every 12" As Per:
Tie Down Engineering
Certified To ANSI A 225.1
Fed. Spec. QQ-S781-B
ASTM D3953.91

Tie Down Engineering	
TITLE: MLFT End Frame Tie Part Number 59188	
SCALE: None	DWG NO. 59188

Pump Owner’s Manual

Redi-Flo3

SQE-NE
Environmental Pumps

Installation and Operating Instructions

- **Efficient Permanent Magnet Motor**
- **High Starting Torque**
- **Soft Start**
  (2 seconds to reach maximum rpm, and maximum pressure)
- **Built-in "Smart" Motor Protection with automatic restart**
- **Communication Through the Redi-Flo3 Status Box**
- **Integrated Protection Against Adverse Conditions**
- **Environmental Materials of Construction**

Please leave these instructions with the pump for future reference

GRUNDFOS®

Leaders in Pump Techn

SAFETY WARNING

Electrical Work

WARNING: To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor (at least the size of the circuit supplying the pump) to the grounding screw provided within the wiring compartment.

Pre-Installation Checklist

1. Well Preparation

If the pump is to be installed in a new well then the well should be fully developed and bailed or blown free of cuttings and sand. The construction of the GRUNDFOS Redi-Flo3 submersibles makes it resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

2. Make Sure You Have the Right Pump

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

3. Pumped Fluid Requirements

Submersible well pumps are designed for pumping turbid free, cool water; free of air or gases. Possible decreased pump performance and life expectancy can occur when operating in conditions outside of this chemistry. Water temperature ideally should not exceed 104°F. Extended pump life and optimal performance can best be obtained through proper well development and in the case of higher fluid temperatures use a cooling shroud.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well (Fig.1). The bottom of the motor should never be installed lower than the bottom of the screen.

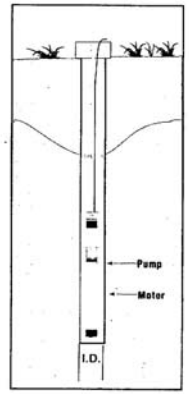


Fig. 1

4. Motor Cooling Requirements

To ensure proper motor cooling refer to the table below for minimum flow requirements:

Flow velocity past the motor	Maximum liquid temperature
0.0 f/s (free convection)	86° F(30°C)
Min. 0.5 f/s	104°F (40°C)

Pre-Installation Checklist

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

Liquid temperatures/cooling

Figure 2 shows an operating Redi-Flo3 pump installed in a well.

Figure 2 illustrates the following:

- Well diameter.
- Pump diameter.
- Temperature of pumped liquid.
- Flow past the motor to the pump strainer.

Note: The well diameter must be at least 3". If there is a risk that the motor will be covered with sediment or the pumped fluid is at an elevated temperature then it is recommended the pump be placed in a Flow Sleeve. The motor should always be installed above the well screen.

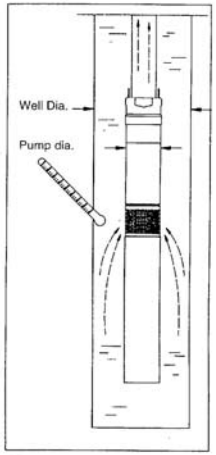


Fig. 2

5. Applications

Typical applications:

Environmental applications such as:

- Remediation pumping.
- Leachate recovery.
- Pollution recovery.
- Dewatering

6. Motor Preparation

GRUNDFOS MSE3-NE submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special GRUNDFOS motor liquid (type SML 2), which will protect the motor fluid down to -4°F(20°C) and to prevent the growth of bacteria. The level of motor fluid is important for the operating life of the bearings and consequently the life of the motor.

Refilling of motor liquid

It is recommended to check and if needed, refill the motor with GRUNDFOS motor fluid SML 2.

Pre-Installation Checklist

To refill the motor, proceed as follows:

1. Remove the cable guard and separate the pump end from the motor.

2. Place the motor in vertical position with an inclination of approx. 10°.

3. Remove the filling plug using a screwdriver or a similar tool.

4. Inject motor liquid into the motor with a filling syringe or similar tool,see fig. 3.

5. To allow possible air to escape, move the motor from side to side. And turn the shaft.

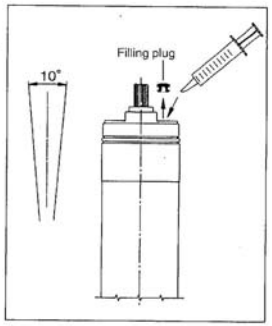


Fig. 3

6. Replace the filling plug and make sure it is tight.

7. Assemble pump end and motor.

8. Install the cable guard.

The pump is now ready for installation.

7. Installation Postions

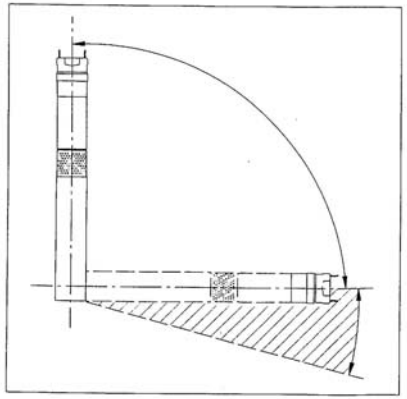


Fig. 4

Positional requirements
The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see fig. 4.

Installation Procedures

8. Electrical connection

General
The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

Before starting work on the pump, make sure the electricity supply has been switched off and that it cannot be accidentally switched on. The pump must be grounded. The pump must be connected to an external mains switch.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate. The required voltage for GRUNDFOS submersible MSE3-NE motors, measured at the motor terminals, is +6%/–10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

Supply voltage:1 x 100-115V or 1 x 200-240 V +6%/–10%, 50/60 Hz.

The current consumption can only accurately be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.
The Redi-Flo3 pumps can be connected to a Redi-Flo3 status box.

Note: The pump must never be connected to a capacitor or to another type of control box other than a Redi-Flo3 status box. The pump must never be connected to an external frequency converter.

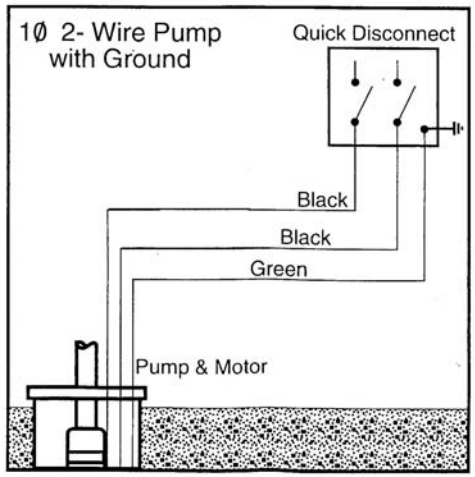
Motor protection
The motor has built-in automatic thermal overload protection and requires no additional motor protection.

Connection of motor
The motor can be connected directly to the main circuit breaker.

9. Making the Wiring Connections

WARNING!
To reduce the risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.

Single-Phase 2-wire Wiring Diagram for GRUNDFOS Motors



A capacitor or control box should NEVER be connected to a Redi-Flo3 submersible pump.

Fig. 5

10. Cable Sizing

SINGLE-PHASE 60 HZ Maximum Cable Length Motor Service to Entrance

Motor Rating		Copper Wire Size								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240

11. Motor Cable

Redi-Flo3 pumps are specifically designed to be used with Grundfos SQE-NE Tefzel motor leads. Standard SQE-NE Tefzel motor leads are available between 25 and 300 foot lengths in 5 foot increments. Custom lengths longer than 300 feet are available in 10 foot increments up to 600 feet from the factory.

General
Note: Do not lower or lift the pump by means of the motor cable.

The loose data plate supplied with the pump should be placed close to the installation site.

12. Installing the cable plug to the motor

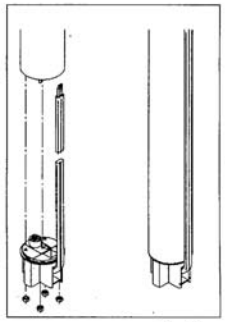


Fig. 6

To install the cable plug, proceed as follows:

1. Check that the cable is of the correct type, cross-section and length.
2. Check that the mains on the location has correct connection to ground.
3. Check that the motor socket is clean and dry.
4. Press the cable plug into the motor socket. The plug will only fit one way, see fig. 6.
5. Install and tighten the four nuts, see fig. 6. When the plug has been installed, there must not be a clearance between the motor and the cable plug.

13. Installing the cable guard

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. The two flaps of the cable guard must engage with the upper edge of the pump sleeve, see fig. 7.

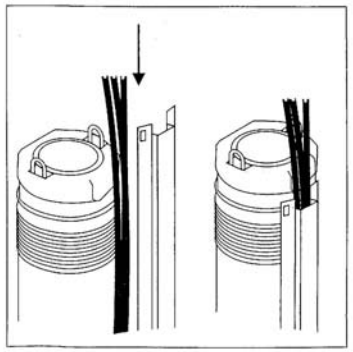


Fig. 7

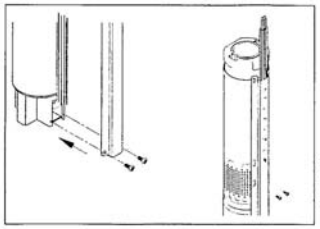


Fig. 8

3. Fasten the cable guard to the cable plug with the four screws supplied, see fig. 8.

14. Piping

- The pump should only be gripped by the two flats at the top of the pump, as shown in fig. 9.
- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.
- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, as shown in fig. 10.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

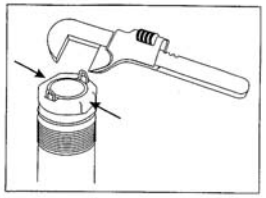


Fig. 9

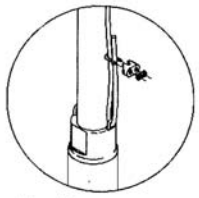


Fig. 10

15. Installing the Pump

Installation Depth
The dynamic water level should always be above the pump see fig. 11.

A = Dynamic water level
B = Static Water Level
C = Minimum 3" well diameter
D = Drawdown
E = Installation depth below static water level. Maximum 500 feet

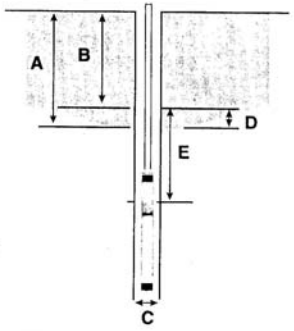


Fig. 11

Procedures
To install the pump, follow these steps:

1. Install the enclosed data plate sticker at the well head.
2. Check the well for proper clearance — the well must be at least 3" in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.

16. Installing the Pump(cont.)

4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well — especially in 3" wells. ***NOTE***: **Do not lower or lift the pump using the motor cable.**
5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal. Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Attach the supplemental information label at the electrical installation site.
8. Complete the electrical connections. **Remember that a capacitor or a control box should NEVER be connected to a Redi-Flo3 submersible pump.**

Installation depths

Maximum installation depth: below the static water level: 500 feet,
Minimum installation depths: 1.75' below the dynamic water level:

Vertical installation:

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation:

The pump must be installed at least 1.75 ft. below the dynamic water level. If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

17. Generator Operation

- It is OK to operate the Redi-Flo3 with a generator.

The generator must be sized 10% above the pumps P1 (Input Power) values.
Use the table to select the correct size generator for the motor HP.

Motor HP	Min. Generator Size (Watts)
1/3 - 1/2 A	1000
1/2 - 3/4 B	1700
1- 1½ C	2000

18. Starting the Pump for the First Time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Motor Cooling and Other Considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Water Impurities

- If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.
- When the water is clean the valve should be fully opened.

Minimum flow rate

- To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than .2 gpm. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield.

Note: The pump's dry-running protection is effective only within the recommended duty range of the pump.

Note: Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.

Operating the Pump

Built-in protection
The motor incorporates an electronic unit which protects the motor in various damaging situations.

In case of overload, the built-in overload protection will stop the pump for 5 minutes. After 5 minutes, the pump will attempt to restart.
If the pump is started and the well has not recovered, the pump will stop after 30 seconds.

If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes or the reset time set by the R100.

Resetting the pump:
Switch off the electricity supply for 1 minute.
The motor is protected against the following conditions:
- dry running,
- voltage surges (up to 5000 V),
- overvoltage,
- undervoltage,
- overload
- overtemperature.

MSE 3NE Motors:
Note: To set Dry-Run limit in the MSE-NE pumps, you need to connect the pump to a Redi-Flo3 status box. Refer to Redi-Flo3 status box I&O for proper connections.

To set Dry-Run protection, follow these steps:
1. Start the pump against closed discharge.
2. Rapidly read the power consumption value (W) in the R100 display 2.5.
3. Multiply this value by 0.9.
4. Within the R100, go to display 4.6 and enter the new value (minimum power limit).
5. Go to display 4.7 and change the setting to "Active".

For further information on dry-running, refer to RediFlo3 Status Box I&O.

Maintenance and service:
The pumps are normally maintenance-free. Deposits and wear may occur. For that purpose, service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request. The pumps can be serviced at a GRUNDFOS service center.

Assembly/Disassembly

19. Assembly of Pump and Motor

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see fig. 12.
2. Grease the motor shaft end with a vegetable based grease.
3. Screw the pump end on the motor. A spanner may be used on the clamping faces of the pump part, see fig.12.
4. Install cable guard as described on page 7.

When pump end and motor have been assembled correctly, there must not be a clearance between pump end and motor.

To disassemble reverse procedure.

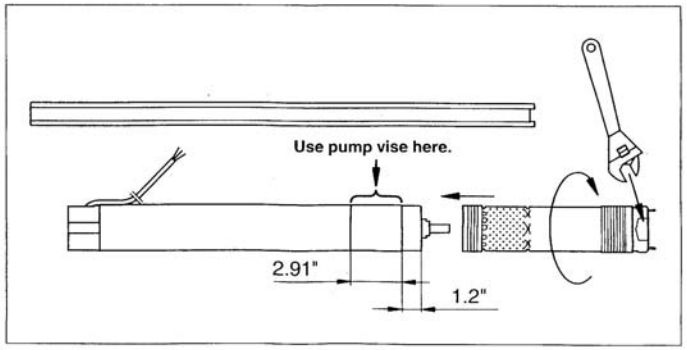


Fig. 12

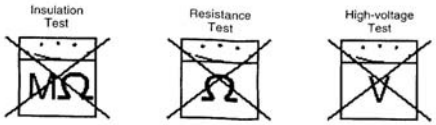
Troubleshooting

Fault	Cause	Remedy
1. The pump does not run	a. The fuses are blown	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b. The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c. No electricity supply.	Contact the Electricity provider.
	d. The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e. The drop cable is defective.	Repair/replace the pump/cable.
	f. Overvoltage has occurred.	Check the electricity supply
2. The pump runs but gives no water.	a. The discharge is closed.	Open the valve
	b. No water or too low water level in well.	See item 3a.
	c. Check valve is stuck in it's closed position.	Pull the pump and clean or replace the valve.
	d. The suction strainer is closed.	Pull the pump and clean the strainer.
	e. The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a. The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b. The valve s in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves as necessary.
	c. The discharge pipe is partly chocked by impurities (Iron bacteria).	Clean/replace the discharge pipe.
	d. The non- return valve of the pump is blocked.	Pull the pump and check/replace the valve.
	e. The pump and the riser pipe are partly choked by impurities (Iron bacteria).	Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	f. The pump is defective.	Repair/replace the pump.
	g. Hole in discharge pipe.	Check and repair the piping.
	h. The riser pipe is defective.	Replace.
	i. Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a. The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b. The water level electrodes or level switches in the reservior have not been installed correctly	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c. Checkvalve is leaking or stuck half-open.	Pull the pump and clean/replace the non-return valve.
	d. The supply voltage is unstable.	Check the electrical supply.
	e. The motor temperature is too high.	Check the water temperature.

Troubleshooting

Instruments not allowed:

Note: The use of the following instruments is not allowed during fault finding:



Note: When measuring, use RMS-instruments.

Checking the motor and cable:

1. Supply voltage 	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified on Page 4, large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption 	Measure the current (RMS) while the pump is operating at a constant discharge head(if possible, at capacity where the motor is heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full load current, there are the following possible faults: Poor connection in the leads, possibly in the cable joint. Too low supply voltage, see item 1 on Page 13.

Environment

During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

⚠ **When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurous to persons and the environment.**

Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. If such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service center.

Technical Data

Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, PE
Operation via Generator:	As a minimum, the generator output must be equal to the motor P1[KW] +10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft starting
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, overtemperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[HP]-1.75 at 230V 0.50-0.75A[HP]-1.4 at 230V 1.0 -1.5C[HP] -1.15 at 230V
Motor Cable: Length	3 Wire, 12 AWG TEFZEL Available in 5 ft. increments from 25ft.- 300ft.
Motor Liquid: **pH Values:**	Type SML 2 Redi-Flo3: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Discharge Port:	5SQE-NE- 1"NPT 10-15SQE-NE- 1 1/4" NPT 22-30SQE-NE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Freeze Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. (**The motor must be stored without being filled with motor liquid.**)
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	34°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MSE3-NE):	
0.33-0.50A[hp]	20.9" length x 2.68" diameter
0.50-0.75B[hp]	20.9" length x 2.68" diameter
1.0-1.5C[hp]	22.3" length x 2.68" diameter
Motor Weights (MSE3-NE):	
0.33-0.50A[hp]	6.0 Lbs
0.50-0.75B[hp]	7.1 Lbs
1.0-1.5C[hp]	8.2 Lbs
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions(min. and max.):	
5SQE-NE	8.1" to 13.6"
10SQE-NE	8.1" to 14.5"
15SQE-NE	8.1" to 14.5"
22SQE-NE	8.1" to 14.5"
30SQE-NE	8.1" to 11.3"
Pump End Weights(min. and max.):	
All Redi-Flo3 Models	2.2 lbs to 3.5 lbs
Well Diameter (minimum):	3"
Installation Depth (Maximum):	500 feet, below static water level.

Technical Data

PUMP TYPE	HP	VOLTAGE	MAX. AMPS
5SQE03A-90-NE	1/3 A	230V/115V	3.9/7.8
5SQE03A-120-NE	1/3 A	230V/115V	3.9/7.8
5SQE05A-170-NE	1/2 A	230V/115V	4.9/9.8
5SQE05B-210-NE	1/2 B	230V	4.9
5SQE05B-250-NE	1/2 B	230V	4.9
5SQE07B-290-NE	3/4 B	230V	7.6
5SQE10C-340-NE	1 C	230V	7.6
5SQE10C-380-NE	1 C	230V	7.6
5SQE10C-420-NE	1 C	230V	7.6
10SQE03A-100-NE	1/3 A	230V/115V	3.9/7.8
10SQE05A-140-NE	1/2 A	230V/115V	4.9/9.8
10SQE05B-180-NE	1/2 B	230V	4.9
10SQE07B-220-NE	3/4 B	230V	7.6
10SQE10C-260-NE	1 C	230V	7.6
10SQE10C-300-NE	1 C	230V	7.6
10SQE15C-340-NE	1 1/2 C	230V	11.1
15SQE03A-70-NE	1/3 A	230V/115V	3.9/7.8
15SQE05A-110-NE	1/2 A	230V/115V	4.9/9.8
15SQE05B-130-NE	1/2 B	230V	4.9
15SQE07B-170-NE	3/4 B	230V	7.6
15SQE10C-200-NE	1 C	230V	7.6
15SQE10C-230-NE	1 C	230V	7.6
15SQE15C-270-NE	1 1/2 C	230V	11.1
22SQE03A-40-NE	1/3 A	230V/115V	3.9/7.8
22SQE05A-80-NE	1/2 A	230V/115V	4.9/9.8
22SQE05B-110-NE	1/2 B	230V	4.9
22SQE07B-140-NE	3/4 B	230V	7.6
22SQE10C-180-NE	1 C	230V	7.6
22SQE15C-210-NE	1 1/2 C	230V	11.1
30SQE05A-40-NE	1/2 A	230V/115V	4.9/9.8
30SQE05B-80-NE	1/2 B	230V	7.6
30SQE10C-120-NE	1 C	230V	7.6
30SQE15C-160-NE	1 1/2 C	230V	11.1

ACCESSORIES	
PRODUCT	**PART NUMBER**
CU 300	96422776
Flow Sleeve	96037505
Grease	96037562
Grundfos SPP1 Potentiometer	625468
RediFlo3 Motor Leads - available in 5ft. increments	See price list
25ft	96037428
50ft	96037429
75ft	96037430
100ft	96037431
125ft	96037432
150ft	96037433
175ft	96037434
200ft	96037435
225ft	96037436
250ft	96037437
300ft	96037438
R100 Infrared Remote	625333
HP Infrared Printer 822408	620480

LIMITED WARRANTY

Products manufactured by GRUNDFOS are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS factory or authorized service station, any product of GRUNDFOS manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

MANUFACTURER WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD "AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING OR REPAIR.

Some jurisdictions do not allow the exclusion or limitation of implied warranties of merchantability and fitness for a particular purpose, of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last or require you to pay certain expenses as set forth above. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facilities is, 1-800-333-1366.

Federal Communications Commission Notice:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

GRUNDFOS®

Leaders in Pump Technology

Grundfos Pumps Corporation • 3131 N. Business Park Ave., Fresno, CA 93727
Customer Service Centers: Allentown, PA • Fresno, CA
Phone: (800) 333-1366 • **Fax:** (800) 333-1363
Canada: Oakville, Ontario • **Mexico:** Apodaca, N.L.
Visit our website at www.us.grundfos.com

96 04 89 31

V7 16 06 46 02 00	US
L-RF-10-008	02/00

xb OFFSET 4668

GRUNDFOS INSTRUCTIONS
Installation and Operation

SQ/SQE

Drinking Water System Components
ANSI/NSF 61
(65GM)

BE›THINK›INNOVATE›

GRUNDFOS

TABLE OF CONTENTS

Before beginning installation procedures, these installation and operating instructions should be studied carefully. The installation and operation should also be in accordance with local regulations and accepted codes of good practice.

GENERAL DESCRIPTION

The SQ/SQE is a 3 inch diameter submersible pump mainly designed for the pumping of raw water in domestic water supply. This manual is designed to assist in the proper set-up, installation and operation of these pumps.

APPLICATIONS

Typical applications are:

- Residential Housing
- Small Waterworks
- Pressure Boosting
- Irrigation Systems
- Liquid Transfer in Tanks

PRE-INSTALLATION CHECKLIST

1. PREINSTALLATION

Well Preparation

If the pump is to be installed in a new well then the well should be fully developed and bailed or blown free of cuttings and sand. The construction of the GRUNDFOS SQ/SQE submersibles makes it resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, the well must be blown or bailed clear of oil.

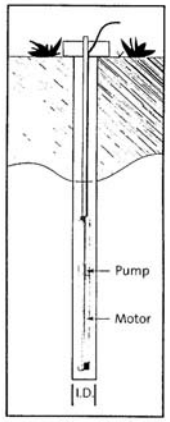


Figure 1

Make Sure You Have the Right Pump

Determine the maximum depth of the well, and the drawdown level at the pump's maximum capacity. Pump selection and setting depth should be made based on this data.

Pumped Fluid Requirements

Submersible well pumps are designed for pumping clear, cold water; free of air or gases. Decreased pump performance and life expectancy can occur if the water is not clear, cold or contains air or gases. Water temperature should not exceed 104°F.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well. The bottom of the motor should never be installed lower than the top the screen or within five feet of the well bottom, as shown in Figure 1.

Motor Cooling Requirements

To ensure proper motor cooling refer to the table below for minimum flow requirements:

FLOW VELOCITY PAST THE MOTOR	MAXIMUM LIQUID TEMPERATURE
0.0 f/s (free convection)	86° F(30°C)
Min. 0.5 f/s	104°F (40°C)

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

Liquid temperatures/cooling

Figure 2 shows an SQ/SQE pump installed in a well. With the pump operating,
Figure 2 illustrates the following:

- Well diameter.
- Pump diameter.
- Temperature of pumped liquid.
- Flow past the motor to the pump
- suction strainer.

Note: The well diameter must be at least 3 inches. If there is a risk that the motor will be covered with sediment then it is recommended the pump be placed in a Flow Sleeve. The motor should always be installed above the well screen.

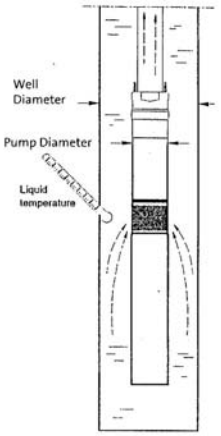


Figure 2

Motor Preparation

GRUNDFOS MS 3 and MSE 3 submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special GRUNDFOS motor liquid (type SML 2), which will protect the motor fluid down to -4°F(20°C) and to prevent the growth of bacteria. The level of motor fluid is important for the operating life of the bearings and consequently the life of the motor.

Refilling of motor liquid

It is recommended to refill the motor with GRUNDFOS motor fluid SML 2.

1. Remove the cable guard and separate the pump end from the motor.
2. Place the motor in vertical position with an inclination of approximately. 10°.
3. Remove the filling plug using a screwdriver or a similar tool.
4. Inject motor liquid into the motor with a filling syringe or similar tool, see Figure 3.
5. To allow possible air to escape, move the motor from side to side. And turn the shaft.
6. Replace the filling plug and make sure it is tight.
7. Assemble pump end and motor.
8. Install the cable guard.

The pump is now ready for installation.

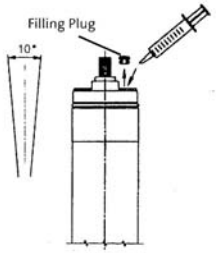


Figure 3

3. INSTALLATION POSITIONS

Positional requirements:

The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see Figure 4.

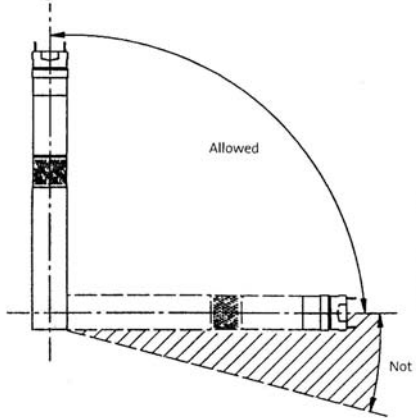


Figure 4

If the pump is to be installed horizontally, e.g.in a tank, it is recommended to fit it in a flow sleeve.

4. ELECTRICAL CONNECTION

General

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

> ⚠ Before starting work on the pump, make sure the electricity supply has been switched off and that it cannot be accidentally switched on. The pump must be grounded. The pump must be connected to an external mains switch.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate. The required voltage for GRUNDFOS submersible MS3/MSE3 motors, measured at the motor terminals, is +6%/–10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).
If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

5. Electrical connection

> Note: The pump must never be connected to a capacitor or to another type of control box other than a CU 300 or CU 301.
> The pump must never be connected to an external frequency converter.

Supply voltage: 1 x 100-115V or 1 x 200-240 V +6%/–10%, 50/60 Hz.

The current consumption can only accurately be measured by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.

The SQE pumps can be connected to a CU 300 or CU 301 status box.

Motor protection

The motor has built-in automatic thermal overload protection and requires no additional motor protection.

Connection of motor

The motor can be connected directly to the main circuit breaker.

Start/stop of the pump will typically be done via a pressure switch, see Figure 5.

Note: The pressure switch must be rated for the maximum amps of the specific pump size.

> WARNING!
> Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.

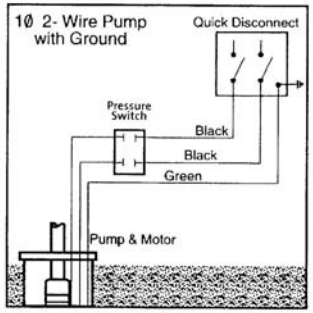


Figure 5

Single-Phase 2-Wire Wiring Diagram for Grundfos Motors

Making the Wiring Connections

A capacitor or control box should NEVER be connected to a SQ/SQE submersible pump.

6. Cable Sizing

SINGLE-PHASE 60 HZ Maximum Cable Length Motor Service to Entrance

Motor Rating		Copper Wire Size								
VOLTS	HP	14	12	10	8	6	4	2	0	00
115	1/3	130	210	340	540	840	1300	1960	2910	
	1/2	100	160	250	390	620	960	1460	2160	
230	1/3	550	880	1390	2190	3400	5250	7960		
	1/2	400	650	1020	1610	2510	3880	5880		
	3/4	300	480	760	1200	1870	2890	4370	6470	
	1	250	400	630	990	1540	2380	3610	5360	6520
	1 1/2	190	310	480	770	1200	1870	2850	4280	5240

7. Splicing the Cable

Splice the drop cable with the motor cable. If the splice is carefully made, it will be as efficient as any other portion of the cable and will be completely watertight.

There are a number of cable splicing kits available today - epoxy filled, rubber-sealed, etc. Many perform well if the manufacturer's directions are followed carefully. If one of these kits is not used, we recommend the following method for splicing the motor cable to the drop cable:

Examine the motor cable and the drop cable carefully for damage.

Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads. Be sure to match the colors.

Strip back and strip off one-inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.

Insert a properly sized Sta-Kon-type connector on each pair of leads, again making sure that colors are matched. Using Sta-Kon crimping pliers, indent the lugs. Be sure to squeeze down hard on the pliers, particularly when using large cable.

Form a piece of electrical putty tightly around each Sta-Kon. The putty should overlap on the insulation of the wire.

Use a good quality tape such as #33 Scotch Waterproof or Plymouth Rubber Company Slipknot Grey.

Wrap each wire and joint tightly for a distance of about 2½ inches on each side of the joint.

Make a minimum of four passes over each joint and overlap each pass approximately one inch to assure a completely watertight seal.

GENERAL

Note: Do not lower or lift the pump by means of the motor cable.

The loose data plate supplied with the pump should be placed close to the installation site.

8. INSTALLING THE CABLE PLUG TO THE MOTOR

The cable plug supplied with the motor is factory-greased. Check that the plug is greased correctly, see Figure 6.

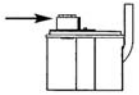


Figure 6

To install the cable plug, proceed as follows:

1. Check that the cable is of the correct type, cross-section and length.
2. Check that the mains on the location has correct connection to ground.
3. Check that the motor socket is clean and dry.
4. Press the cable plug into the motor socket. The plug will only fit one way, see Figure 7.
5. Install and tighten the four nuts, see Figure 7. When the plug has been installed, there must not be a clearance between the motor and the cable plug.

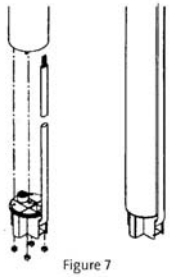


Figure 7

9. INSTALLING THE CABLE GUARD

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. The two flaps of the cable guard must engage with the upper edge of the pump sleeve, see Figure 8.
3. Fasten the cable guard to the cap plug with the four screws supplied, see figure 9.

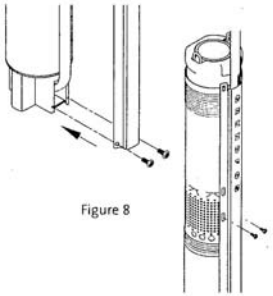


Figure 8

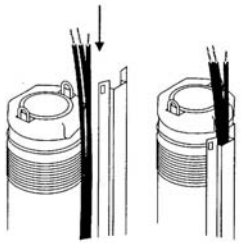


Figure 9

10. PIPING

- The pump should only be gripped by the two flats at the top of the pump, as shown in Figure 10.

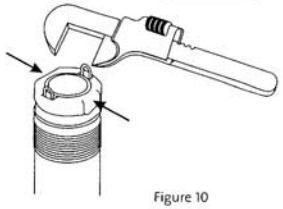


Figure 10

- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.
- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, as shown in circle insert 2, Figure 11.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

11. INSTALLING THE PUMP

Installation Depth

The dynamic water level should always be above the pump. See fig. 11.

A = Dynamic water level
B = Static Water Level
C = Minimum 3 inch well diameter
D = Drawdown
E = Installation depth below static water level. Maximum 500 feet

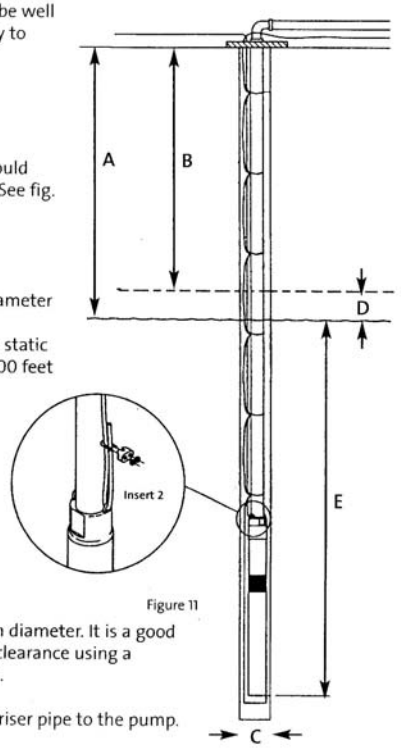


Figure 11

Procedures

To install the pump, follow these steps:

1. Install the enclosed data plate sticker at the well head.
2. Check the well for proper clearance — the well must be at least 3inches in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.

11. INSTALLING THE PUMP (CONTINUED.)

4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well — especially in 3 inch wells.

NOTE: Do not lower or lift the pump using the motor cable.

5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal. Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Attach the supplemental information label at the electrical installation site.
8. Complete the electrical connections.

Remember that a capacitor or a control box should NEVER be connected to a SQ/SQE submersible pump.

Installation depths

Maximum installation depth: below the static water level: 500 feet,
Minimum installation depths: 1.75 feet below the dynamic water level:

Vertical installation:

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation:

The pump must be installed at least 1.75 feet below the dynamic water level. If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

Note: Do not lower or lift the pump with the motor cable.

12. Generator Operation

It is safe to operate the SQ/SQE with a generator.
The generator must be sized 50% above the pumps P1 (input Power) values. See following chart.

Motor HP	Min. Generator Size (Watts)	Recommended Generator Output (Watts)
1/3 -1 /2 A	1100	1500
1/2 - 3/4 B	1700	2300
1 -1 1/2 C	2000	3500

13. Starting the Pump for the First Time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one-third. Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

Motor Cooling and Other Considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must immediately be stopped and the fault remedied.

Water Impurities

- If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.
- When the water is clean the valve should be fully opened.

Minimum flow rate

- To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than 0.2 gpm. If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must be stopped and the fault corrected.

Note: The pump's dry-running protection is effective only within the recommended duty range of the pump.

Note: Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.

Built-in protection
The motor incorporates an electronic unit which protects the motor in various situations.
In case of overload, the built-in overload protection will stop the pump for 5 minutes. After that period, the pump will attempt to restart.
If the pump is started and the well has not recovered, the pump will stop after 30 seconds.

If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes.

Resetting the pump:
Switch off the electricity supply for 1 minute.
The motor is protected against the following conditions:
- dry running,
- voltage surges (up to 4000 V),
- overvoltage,
- undervoltage,
- overload
- over-temperature.

MS 3 Motors:
Note: All MS 3 motors are factory set to detect dry running conditions. However, it is important to ensure that the configurations of both the SQ pump and motor are the same configuration. Configurations can be found on both SQ pump and motor nameplates as " Config."
EXAMPLE: Config. A-2, must match the other nameplate A-2. See Technical Data on page 17 for quick referencing on all configurations.

MSE 3 Motors:
Note: To set Dry-Run limit in the MSE/SQE pumps, you need to connect the pump to a CU 300. Refer to CU 300 I&O for proper connections.
To set Dry-Run protection, follow these steps:
1. Start the pump against closed discharge.
2. Rapidly read the power consumption value (W) in the R100 display 2.5.
3. Multiply this value by 0.9.
4. Within the R100, go to display 4.6 and enter the new value (minimum power limit).
5. Go to display 4.7 and change the setting to "Active".

For further information on dry-running, refer to CU 300 I&O.

Maintenance and service:
The pumps are normally maintenance-free.
Deposits and wear may occur. For that purpose, service kits and service tools are available from GRUNDFOS. The GRUNDFOS Service Manual is available on request.
The pumps can be serviced at a GRUNDFOS service center.

19. ASSEMBLY OF PUMP AND MOTOR

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see Figure 12.
2. Grease the motor shaft end with the grease supplied with the motor.
3. Screw the pump end on the motor. A spanner may be used on the clamping faces of the pump part, see Figure 12.
4. Install cable guard as described on page 7.

When pump end and motor have been assembled correctly, there must not be a clearance between pump end and motor.

To disassemble reverse procedure.

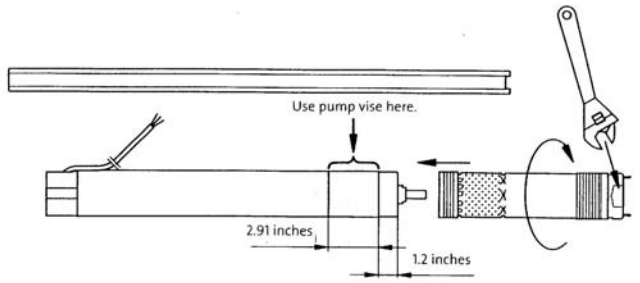
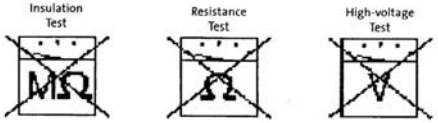


Figure 12

Fault	Cause	Remedy
1. The pump does not run	a. The fuses are blown	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b. The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c. No electricity supply.	Contact the Electricity provider.
	d. The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e. The drop cable is defective.	Repair/replace the pump/cable.
	f. Overvoltage has occurred.	Check the electricity supply
2. The pump runs but gives no water.	a. The discharge is closed.	Open the valve
	b. No water or too low water level in well.	See item 3a.
	c. Check valve is stuck in it's closed position.	Pull the pump and clean or replace the valve.
	d. The suction strainer is closed.	Pull the pump and clean the strainer.
	e. The pump is defective.	Repair/replace the pump.
3. The pump runs at reduced capacity.	a. The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b. The valve s in the discharge pipe are partly closed/blocked.	Check and clean/replace the valves as necessary.
	c. The discharge pipe is partly chocked by impurities (Iron bacteria).	Clean/replace the discharge pipe.
	d. The non-return valve of the pump is blocked.	Pull the pump and check/replace the valve.
	e. The pump and the riser pipe are partly choked by impurities (Iron bacteria).	Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	f. The pump is defective.	Repair/replace the pump.
	g. Hole in discharge pipe.	Check and repair the piping.
	h. The riser pipe is defective.	Replace.
	i. Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a. The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply.
	b. The water level electrodes or level switches in the reservoir have not been installed correctly	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c. Check-valve is leaking or stuck half-open.	Pull the pump and clean/replace the non-return valve.
	d. The supply voltage is unstable.	Check the electrical supply.

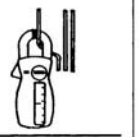
Instruments not allowed:

Note: The use of the following instruments is not allowed during fault finding:



Note: When measuring, use RMS-instruments.

Checking the motor and cable:

1. Supply voltage 	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified on Page 4, large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption 	Measure the current (RMS) while the pump is operating at a constant discharge head(if possible, at capacity where the motor is heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full load current, there are the following possible faults: Poor connection in the leads, possibly in the cable joint. Too low supply voltage, see item 1 on Page 13.

Environment

During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurious to persons and the environment.

Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.
2. If such waste collection service does not exist or cannot handle the materials used in the product, please deliver the product or any hazardous materials from it to your nearest GRUNDFOS company or service center.

Supply Voltage:	1x200-240V +6%/-10%, 50/60 Hz, LE 1x100-115V +6%/-10%, 50/60 Hz, LE
Operation via Generator:	Recommended generator output must be equal to P1[KW] +50% and minimum P1+10%
Starting Current:	The motor starting current is equal to the highest value stated on the motor nameplate
Starting:	Soft starting
Run-up Time:	Maximum : 2 seconds
Motor Protection:	The motor is protected against: Dry running, overvoltage, undervoltage, overload, over-temperature
Power Factor:	PF= 1
Service Factor:	0.33-0.50A[HP]-1.75 at 115V/230V 0.50-0.75A[HP]-1.4 at 230V 1.0 -1.5C[HP] -1.15 at 230V
Motor Cable: Length	3 Wire, 14 AWG XLPE 5 ft
Motor Liquid: **pH Values:**	Type SML 2 SQ and SQE: 5 to 9
Liquid Temperature:	The temperature of the pumped liquid must not exceed 104°F.
Note: if liquids with a viscosity higher than that of water are to be pumped, please contact GRUNDFOS	
Discharge Port:	5SQ/SQE- 1"NPT 10-15SQ/SQE- 1 1/4" NPT 22-30SQ/SQE- 1 1/2" NPT
STORAGE CONDITIONS	
Minimum Ambient Temperature:	-4°F
Maximum Ambient Temperature:	+140°F
Freeze Protection:	If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof. (**The motor must be stored without being filled with motor liquid.**)
OPERATING CONDITIONS	
Minimum Ambient Fluid Temperature:	-4°F
Maximum Ambient Fluid Temperature:	+104°F
APPROXIMATE DIMENSIONS AND WEIGHT	
Motor Dimensions (MS 3 & MSE 3):	
0.33-0.50A[hp]	20.9" length x 2.68" diameter
0.50-0.75B[hp]	20.9" length x 2.68" diameter
1.0-1.5C[hp]	22.3" length x 2.68" diameter
Motor Weights (MS 3 & MSE 3):	
0.33-0.50A[hp]	6.0 Lbs.
0.50-0.75B[hp]	7.1 Lbs.
1.0-1.5C[hp]	8.2 Lbs.
Pump End Dimensions:	
Pump Diameter:	2.68"
Pump Diameter, incl. cable guard:	2.91"
Pump End Dimensions(min. and max.):	
5SQ/SQE	10.6" to 18.0"
10SQ/SQE	10.6" to 16.9"
15SQ/SQE	10.6" to 16.9"
22SQ/SQE	10.6" to 16.9"
30SQ/SQE	10.6" to 13.7"
Pump End Weights(min. and max.):	
All SQ/SQE Models	2.2 lbs. to 3.5 lbs.
Well Diameter (minimum):	3"
Installation Depth (Maximum):	500 feet, below static water level.

TECHNICAL DATA

PUMP TYPE	HP	VOLTAGE	FLOW RANGE	MIN. WELL DIA	DISCH.
5SQ/SQE03A-90	1/3 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE03A-140	1/3 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05A-180	1/2 A	230V/115V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05B-230	1/2 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE05B-270	1/2 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE07B-320	3/4 B	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-360	1 C	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-410	1 C	230V	1.5-7.5 GPM	3"	1" NPT
5SQ/SQE10C-450	1 C	230V	1.5-7.5 GPM	3"	1" NPT
10SQ/SQE03A-110	1/3 A	230V/115V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE05B-160	1/2 B	230V/115V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE05B-200	1/2 B	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-240	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-290	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE10C-330	1 C	230V	3-15 GPM	3"	1 1/4" NPT
10SQ/SQE15C-380	1 1/2 C	230V	3-15 GPM	3"	1 1/4" NPT
15SQ/SQE03A-70	1/3 A	230V/115V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE05A-110	1/2 A	230V/115V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE05B-150	1/2 B	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE07B-180	3/4 B	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE10C-220	1 C	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE10C-250	1 C	230V	4-20 GPM	3"	1 1/4" NPT
15SQ/SQE15C-290	1 1/2 C	230V	4-20 GPM	3"	1 1/4" NPT
22SQ/SQE03A-40	1/3 A	230V/115V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE05A-80	1/2 A	230V/115V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE05B-120	1/2 B	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE10C-160	1 C	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE10C-190	1 C	230V	7-33 GPM	3"	1 1/2" NPT
22SQ/SQE15C-220	1 1/2 C	230V	7-33 GPM	3"	1 1/2" NPT
30SQ/SQE05A-40	1/2 A	230V/115V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE05B-90	1/2 B	230V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE10C-130	1 C	230V	8-42 GPM	3"	1 1/2" NPT
30SQ/SQE15C-170	1 1/2 C	230V	8-42 GPM	3"	1 1/2" NPT

ACCESSORIES	
PRODUCT	**PART NUMBER**
CU 300	96422776
CU 301	96436754
FLOW SLEEVE	96037505
GREASE	96037562
FLOW SWITCH	96022967
PRESSURE TRANSMITTER	96026030

NOTES

LIMITED WARRANTY

Products manufactured by (GRUNDFOS) GRUNDFOS PUMPS CORPORATION are warranted to the original user only to be free of defects in material and workmanship for a period of 18 months from date of installation, but not more than 24 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE. EXCEPT AS EXPRESSLY HEREIN PROVIDED THE GOODS ARE SOLD"AS IS", THE ENTIRE RISK AS TO QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, AND PERFORMANCE OF THE GOODS IS WITH THE BUYER, AND SHOULD THE GOODS PROVE DEFECTIVE FOLLOWING THEIR PURCHASE, THE BUYER AND NOT THE MANUFACTURER, DISTRIBUTOR, OR RETAILER ASSUMES THE ENTIRE RISK OF ALL NECESSARY SERVICING AND REPAIR.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

The telephone number of our service and repair facilities central directory, from which you can obtain the locations of our service and repair facility is, 1-800-333-1366.

Grundfos Pumps Corporation • 17100 W. 118th Terrace • Olathe, KS 66061
Customer Service Phone: 800.333.1366 • **Fax:** 800.333.1363
Canada: Oakville, Ontario • **Mexico:** Apodaca, N.L.

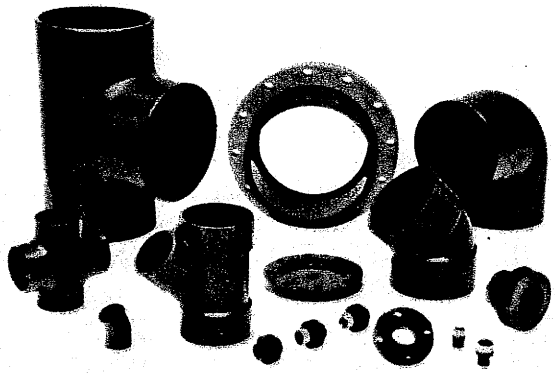
96 47 78 69
L-SP-TL-017 Rev. 11/01
Printed in the U.S.A.

Manufacturer's Descriptive and Technical Literature

PVC SCHEDULE 80 FITTINGS

80-2-0199

Performance Engineered & Tested



SPEARS Schedule 80 PVC fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material reinforcement is uniformly placed in stress concentration areas for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure obtaining the very best PVC fittings available.

Full 1/4" Through 12" Availability

Spears comprehensive line of injection molded PVC fittings offers a variety of configurations in molded Schedule 80 sizes 1/4" through 12" conforming to ASTM D 2467 and Spears exclusive CL150 Flanges in sizes 1/2" through 16".

Exceptional Chemical & Corrosion Resistance

Unlike metal, PVC fittings never rust, scale, or pit, and will provide many years of maintenance-free service and extended system life.

High Temperature Ratings

PVC, thermoplastic can handle fluids at service temperatures up to 140°F (60°C), allowing a wide range of process applications, including corrosive liquids.

Lower Installation Costs

Substantially lower material costs than steel alloys or lined steel, combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.

Higher Flow Capacity

Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.

Additional Fabricated Configurations through 36"

Extra large, hard-to-find, and custom configurations are fabricated from NSF Certified pipe. Fittings are engineered and tested to provide full pressure handling capabilities according to Spears specifications.

Advanced Design Specialty Fittings

Spears wide range of innovative, improved products include numerous metal-to-plastic transition fittings and unions with Spears' patented stainless steel reinforced (SR) plastic threads.

PVC Valves

SPEARS PVC Valve products are available for total system compatibility and uniformity; see SPEARS' THERMOPLASTIC VALVES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS (V-4).

Sample Engineering Specifications

All PVC Schedule 80 fittings shall be produced by Spears Manufacturing Company from PVC Type I, cell classification 12454, conforming to ASTM Standard D 1784. All injection molded PVC Schedule 80 fittings shall be Certified for potable water service by NSF International and manufactured in strict compliance to ASTM D 2467. All fabricated fittings shall be produced in accordance with Spears General Specifications for Fabricated Fittings. All PVC flanges shall be designed and manufactured to meet CL150 bolt pattern per ANSI Standard B16.5 and rated for a maximum internal pressure of 150 psi, non-shock at 73°F.

Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001

PROGRESSIVE PRODUCTS FROM SPEARS INNOVATION & TECHNOLOGY

PVC Thermoplastic Pipe Temperature Pressure De-Rating

System Operating Temperature °F (°C)	73 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)
PVC	100%	90%	75%	62%	50%	40%	30%	22%

NOTE: Valves, Unions and Specialty Products have different elevated temperature ratings than pipe.

PVC Basic Physical Properties

Properties	ASTM Test Method	PVC
Mechanical Properties, 73°F		
Specific Gravity, g/cm	D 792	1.40
Tensile Strength, psi	D 638	7,000
Modulus of Elasticity, psi	D 638	440,000
Compressive Strength, psi	D 695	9,000
Flexural Strength, psi	D 790	13,200
Izod Impact, notched, ft-lb/in	D 256	.65
Thermal Properties		
Heat Deflection Temperature, °F at 66 psi	D 648	165
Thermal Conductivity, BTU/hr/sq ft/°F/in	C 177	1.2
Coefficient of Linear Expansion, in/in/°F	D 696	3.0×10^{-5}
Flammability		
Limiting Oxygen Index, %	D 2863	43
UL 94 Rating	94V-0	
Other Properties		
Water Absorption, % 24 hr.	D 570	.05
Industry Standard Color	White / Gray	
ASTM Cell Classification	D 1784	12454
NSF Potable Water Approved	Yes	

PVC Chemical Resistance

PVC is generally inert to most mineral acids, bases, salts and paraffinic hydrocarbon solutions. For more information on PVC chemical resistance refer to the Chemical Resistance of Rigid Geon® Vinyls Based on Immersion Test, published by the GEON® company.

NOT FOR USE WITH COMPRESSED AIR OR GASES

Spears Manufacturing Company DOES NOT RECOMMEND the use of thermoplastic piping products for systems to transport or store compressed air or gases, or the testing of thermoplastic piping systems with compressed air or gases in above and below ground locations. The use of our product in compressed air or gas systems automatically voids any warranty for such products, and its use against our recommendation is entirely the responsibility and liability of the installer.

WARNING: DO NOT USE COMPRESSED AIR OR GAS TO TEST ANY PVC OR CPVC THERMOPLASTIC PIPING PRODUCT OR SYSTEM, AND DO NOT USE DEVICES PROPELLED BY COMPRESSED AIR OR GAS TO CLEAR SYSTEMS. THESE PRACTICES MAY RESULT IN EXPLOSIVE FRAGMENTATION OF SYSTEM PIPING COMPONENTS CAUSING SERIOUS OR FATAL BODILY INJURY.

SPEARS® MANUFACTURING COMPANY

CORPORATE OFFICES
15853 Olden Street, Sylmar, CA 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611 • http://www.spearsmfg.com

PACIFIC SOUTHWEST
15860 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611
(800) 862-1499
FAX: (818) 367-3014

NORTHWEST
3902 "B" Street N.W.
Auburn (Seattle), WA
98002
(253) 939-4433
(800) 347-7327
FAX: (253) 939-7557

ROCKY MOUNTAIN
4800 Nome Street
Denver, CO
80239
(303) 371-9430
(800) 777-4154
FAX: (303) 375-9546

SOUTH CENTRAL
1838 Forms Drive
Carrollton (Dallas), TX
75006
(972) 245-0387
(800) 441-1437
FAX: (972) 245-4205

UTAH
1415 South 700 West #3
Salt Lake City, UT
84104
(801) 972-0659
FAX: (801) 972-0688

NORTHEAST
543 Industrial Drive
Lewisberry (Harrisburg), PA
17339-9532
(717) 938-8844
(800) 233-0275
FAX: (717) 938-6547

SOUTHEAST
2751 Miller Road
Decatur (Atlanta), GA
30035
(770) 981-7122
(800) 662-6326
FAX: (770) 981-6106

FLORIDA
3445 Bartlett Boulevard
Orlando, FL
32811
(407) 843-1960
(800) 327-6390
FAX: (407) 425-3563

MIDWEST
854 Fairway Drive
Bensenville (Chicago), IL
60106
(630) 773-0075
(800) 662-6330
FAX: (630) 773-0435

INTERNATIONAL SALES
15853 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203
Sylmar, CA 91392
(818) 364-1611
FAX: (818) 898-3774
E-mail: export@spearsmfg.com

 80-2-0199

Test Procedures

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 8, 2003

Test Procedure Submittal

A: Line Identification:
Spray system & supply line

B: Test Pressure:
75 pounds per square inch gauge pressure for 2 hours. The piping system shall be held at test pressure for a minimum of 30 minutes then the length of pipe will be walked to check for any visible leaks.

C: Identification of lines in Each Group:

Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 8, 2003

Test Procedure Submittal

A: Line Identification:
Spray system & supply line

B: Test Pressure:
75 pounds per square inch gauge pressure for 2 hours. The piping system shall be held at test pressure for a minimum of 30 minutes then the length of pipe will be walked to check for any visible leaks.

C: Identification of lines in Each Group:

Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 8, 2003

Test Procedure Submittal

A: Line Identification:
Spray system & supply line

B: Test Pressure:
75 pounds per square inch gauge pressure for 2 hours. The piping system shall be held at test pressure for a minimum of 30 minutes then the length of pipe will be walked to check for any visible leaks.

C: Identification of lines in Each Group:

Group #1:	6" PVC from 0+00 to approximately 3+75 including associated valves and fittings.
Group #2:	4" PVC from approximately 3+75 to 6+00 including associated valves and fittings.
Group #3:	3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

D: Identification of Connected Equipment:
None

E: Test Medium to be Used in Each Group:

Group #1:	Water
Group #2:	Water
Group #3:	Water

F: Location of Test Blinds on Caps or Seals in Each Group:
3" blind flange located at Station 8+18.84.

Palisade Constructors, Inc.

S. M. Stoller Corporation

Field Test Reports

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 7, 2003 and August 8, 2003

2. 1 ¼" pipe fittings and valves from the check valve to pitless adapter (each well).

3. Test Medium - Water

4. Test Pressure and Duration:
Each well pressured to 75 pounds PSI holding gauge pressure for 30 minutes.

5. Test Log:
Each well vault section flushed of dirt and debris with water, pumped up to pressure.

Well Number:
470 – Leak at 1 ¼" T for sample valve. T replaced and brought back to pressure and held for 30 minutes.
471 – No leaks detected.
472 – Leak at T filter. T filter replaced and brought back to pressure and held for 30 minutes.
473 – Leak at ¾" nipple on sample valve. ¾" nipple replaced and brought back to pressure and held for 30 minutes.
474 – No leaks detected.
475 – No leaks detected.
476 – Leak at 1" to 1 ¼" bushing at flow control valve. Bushing replaced and brought back to pressure and held for 30 minutes.
477 – Leak at ¾" nipple at drain valve. ¾" nipple replaced and brought back to pressure and held for 30 minutes.
478 – No leaks detected.
479 – No leaks detected.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Jesus Galindo	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade **C**onstructors, **I**nc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 11, 2003

2. Well Field header from Well Number 470 to Station 3.75 including water meter, pressure gauge and sample valve, air vacuum release and 10 check valves to well laterals.

3. Test Medium - Water

4. Test Pressure and Duration:
Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
Line was flushed of dirt and debris with water and pumped up to pressure. Glue joint on 45 Degree at Station 2.75 was leaking. Replaced 45 Degree. 4x4x1 ½" leaking. Found it was not glued, glued together and brought back up to pressure and held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Jesus Galindo	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 14, 2003

2. 4" Class 160 field piping from Station 3+75 to 13+95 including drain and air vacuum release valve.

3. Test Medium - Water

4. Test Pressure and Duration:
Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
Line was flushed of dirt and debris with water and pumped up to pressure. No leaks detected and pressure held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Lynn VonEhrenkrook	Palisade Constructors, Inc.
Tony Satterfield	Palisade Constructors, Inc.
Randy Stevenson	S. M. Stoller Corporation

Palisade Constructors, Inc.

695 36 Road
Palisade, CO 81526
Tel. (970) 464-7371
Fax (970) 464-7569

August 22, 2003

FIELD TEST REPORT

1. Test Date: August 19, 2003

2. Spray System and Supply Line – 6" PVC 0+00 to 3+75 including associated valves and fittings. 4" PVC from 3+75 to 6+00 including associated valves an fittings. 3" PVC from 6+00 to 8+18.84 including associated valves and fittings.

3. Test Medium - Water

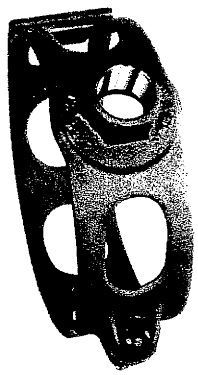
4. Test Pressure and Duration:
Line pressured to 75 pounds PSI and holding gauge pressure for 30 minutes.

5. Test Log:
Line flushed of dirt and debris with water and pumped up to pressure. No leaks detected and pressure held for 30 minutes.

6. Persons present during Testing:

Don Gaumer	S. M. Stoller Corporation
Tony Satterfield	Palisade Constructors, Inc.
Michael Reynolds	Palisade Constructors, Inc.

Literature for Components



MODEL 3401 BRONZE SADDLE FOR IPS PVC

BODY CASTINGS: Waterworks Bronze (85-5-5-5) per ASTM B584 and AWWA C800.

FASTENERS: Silicon Bronze per ASTM B98.

GASKET: Patented SBR TwinSeal® dual o-ring design incorporating both hydro-static and mechanical forces to affect a dynamic seal.

SUBMITTAL REVIEW
Review is only for general conformity with the design concept and is limited to requirements stated for the contract documents. Sub contractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
___ Furnish as Corrected
___ Amend and Resubmit
___ Rejected

Date 6/27/03 Department ENG
By mW Medul

Pipe Size		Pipe OD		TwinSeal Hinged Design for IPS PVC Pipe						
in.	mm.	in.	mm.	Box Qty	3/4 CC or NPT Outlet	1 CC or NPT Outlet	1 1/4 CC or NPT Outlet	1 1/2 CC or NPT Outlet	2 CC or NPT Outlet
1 1/4	32	1.66	42	25	$18.80*		N/A		
1 1/2	40	1.90	48	25	18.80*		N/A		
2	50	2.38	60	20	18.90		N/A		
2 1/2	65	2.88	73	12	22.50		N/A		
3	80	3.50	84	10	23.40		$44.20		
3 1/2	90	4.00	101	10	26.00		N/A		
4	100	4.50	114	8	27.40		46.20		
5	125	5.56	141	8	35.20		N/A		
6	150	6.63	168	8	35.30		55.30		
8	200	8.63	219	6	44.00		62.50		
10	250	10.75	273	6	85.00		113.10		
12	300	12.75	324	3	113.10		118.90		

HOW TO ORDER : Choose nominal pipe size x outlet size and thread configuration.
EXAMPLE: 4" PVC O.D. 4.50 with 3/4CC outlet. Order 3401 - 4 x 3/4 CC.

***NOTE :** 1 1/2", 1 1/4" x 1" NOT AVAILABLE

MODEL 3402 BRONZE SADDLE FOR COPPER TUBING

Pipe Size		Pipe OD		TwinSeal Hinged Design for Copper Tubing		
in.	mm.	in.	mm.	Box Qty	1 CC or NPT Outlet	3/4 CC or NPT Outlet
2	50	2.13	60	20	$25.30	
2 1/2	65	2.63	73	12	30.00	
3	80	3.13	84	10	31.20	

Note: Saddles on pages B-1 and B-2 must be ordered in box quantities

Material Specifications Subject to Change.

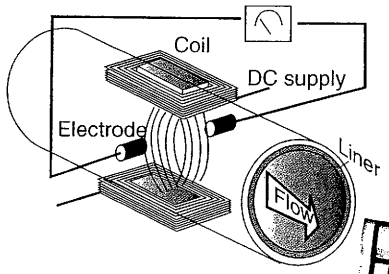
Magnetoflow® Mag Meter	Model Magnetoflow Flanged	Technical Brief

GENERAL

Badger's Magnetoflow line is the result of 35 years of research and field use in electromagnetic flow meters. Based on Faraday's law of induction, these meters can measure almost any liquid, slurry or paste that has a minimum of electrical conductivity. Designed, developed and manufactured under the strictest quality standards, the Magnetoflow meter ranks among the best in the market. Its sophisticated, processor based signal conversion represents the state of the art in the industry with accuracies of 0.25% or better. The wide selection of liner and electrode materials insures maximum compatibility and minimum maintenance over a long operating period.

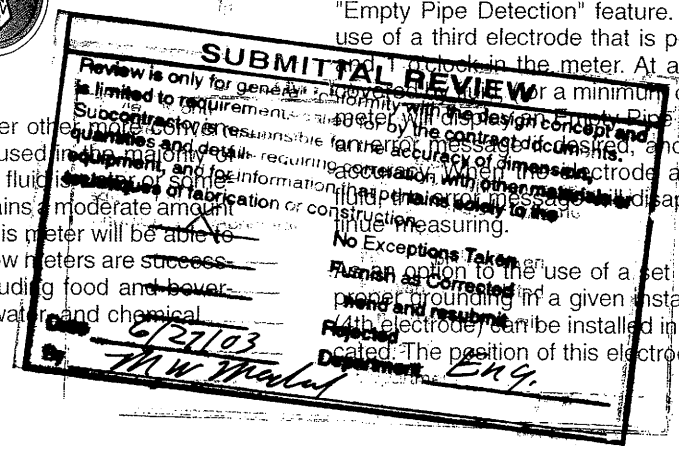
OPERATION

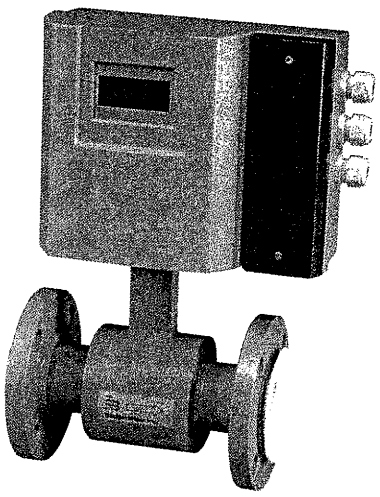
The flow meter is basically a stainless steel tube lined with a nonconductive material. Outside the tube two DC powered electromagnetic coils are positioned diametrically opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. When the coils are energized, a magnetic field is created across the whole diameter of the pipe. When a conductive fluid flows through this magnetic field, a voltage is induced across the electrodes. This voltage is directly proportional to the average flow velocity of the fluid and is picked up by the two electrodes. This induced voltage is then amplified and processed digitally by the converter to produce a very accurate analog or digital signal. The signal can then be used to indicate flow rate, totalization or to communicate to remote sensors and controllers. The main advantages of this technology are that with no parts in the flow stream, there is no pressure loss, the accuracy is not affected by temperature, pressure, viscosity, density or flow profile and with no moving parts there is practically no maintenance required.



APPLICATION

Because of its inherent advantages over other more conventional technologies, this meter can be used in the majority of industrial flow applications. Whether the fluid is something highly corrosive, very viscous, contains a moderate amount of solids or requires special handling, this meter will be able to accurately measure it. Today Magnetoflow meters are successfully being used in most industries including food and beverage, pharmaceutical, water and wastewater and chemical.





Magnetoflow® Flanged

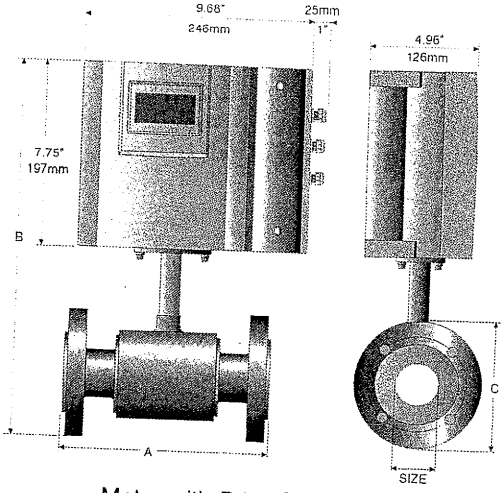
FEATURES

- 0.25% accuracy independent of fluid viscosity, density and temperature
- Unaffected by most solids contained in fluids
- Pulsed DC magnetic field for zero point stability
- No pressure loss for low operational costs
- Long life corrosion resistant liners
- Calibrated in state of the art facilities
- Integral and remote signal converter availability
- Optional grounding rings or grounding electrode
- Measurement largely independent of flow profile

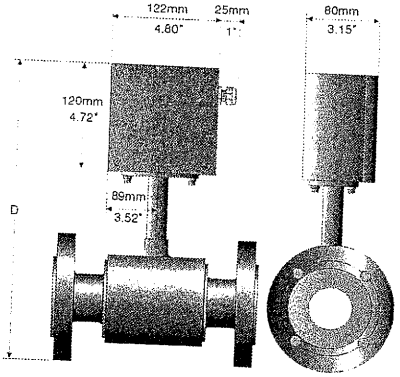
Electrodes

The two measuring electrodes, when looking from the end of the meter into the inside bore, are positioned at 3 o'clock and 9 o'clock. Badger Meter's Magnetoflow Mag meters have an "Empty Pipe Detection" feature. This is accomplished by the use of a third electrode that is positioned between 12 o'clock and 1 o'clock in the meter. At any time this electrode is not covered with fluid (for a minimum of a five second duration), the meter will display an Empty Pipe Detection condition, send out an error message, if desired, and stop measuring to maintain accuracy. When the electrode again becomes covered with fluid the error message will disappear and the meter will continue measuring.

An option to the use of a set of grounding rings, to assure proper grounding in a given installation a grounding electrode (4th electrode) can be installed in the meter when initially fabricated. The position of this electrode is about 5 o'clock.



Meter with Primo® Amplifier



Meter with junction box for remote Primo® Amplifier

Size		A		B		C		D		Est. Weight with Primo		Flow Range			
												LPM		GPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	Lbs	Kg	Min	Max	Min	M
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.063	20	0.02	
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.114	34	0.03	
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.177	53	0.05	
1/2	15	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5	0.416	125	0.11	
3/4	20	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0	0.75	225	0.2	
1	25	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0	1.20	350	0.3	
1 1/4	32	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5	2.00	575	0.5	1
1 1/2	40	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5	3.00	900	0.8	2
2	50	11.0	280	17.1	434	7.0	178	14.4	366	54	24.5	4.70	1400	1	3
2 1/2	65	11.0	280	17.3	440	7.5	191	14.7	372	56	25.5	8	2400	2	6
3	80	11.0	280	18.4	466	9.0	229	15.7	398	58	26.5	12	3600	3	9
4	100	15.8	400	19.6	498	10.0	254	16.9	430	60	27.0	19	5600	5	14
5	125	15.8	400	20.6	524	11.0	279	17.9	456	62	28.0	30	8800	8	23
6	150	15.8	400	22.5	572	13.5	343	20.4	518	88	40.0	40	12700	11	33
8	200	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0	75	22600	20	59
10	250	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0	120	35300	30	93
12	300	23.6	590	30.8	782	21.0	533	28.2	716	260	118	170	50800	45	134
14	350	23.6	590	33.7	856	23.5	597	31.0	788	308	140	230	69200	60	182
16	400	23.6	590	35.0	890	25.0	635	32.4	822	287	130	300	90400	80	239
18	450	23.6	590	38.2	969	27.5	699	35.5	901	495	225	380	114000	100	302
20	500	23.6	590	39.6	1005	29.5	749	36.9	937	441	200	470	140000	125	373
22	550	23.6	590	42.2	1071	32.0	813	39.5	1003	554	252	570	170000	150	451
24	600	23.6	590	46.2	1173	36.5	927	44.0	1118	650	295	680	200000	180	537
28	700	23.6	590	48.3	1228	39.0	984	45.7	1161	704	320	920	275000	240	731
30	750	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350	1060	315000	280	840
32	800	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386	1200	361000	320	956
36	900	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420	1500	457000	400	1210
40	1000	31.5	800	66.0	1675	53.0	1346	63.4	1610	1100	500	1900	565000	500	1493
42	1050	36.0	800	69.9	1775	59.4	1455	67.2	1707	1210	550	2100	620000	550	1646
48	1200	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620	2700	814000	720	2151
54	1400	39.4	1000									3700	1100000	980	2927

SPECIFICATIONS - Detector

Flow Range: 0.1 - 39.4 fps (0.03-12 m/s)
Sizes: 1/4" to 54" (16 to 1400 mm)
Min. Conductivity: ≥ 5 micromhos/cm
Accuracy:
± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Electrode Materials: Standard: Alloy C
Optional: 316 Stainless Steel, Gold/Platinum Plated, Tantalum, Platinum/Rhodium
Liner Material: PFA up to 3/8", PTFE 1/2" thru 24", PTFE up to 24", Soft and Hard Rubber from 1" to 54", Halar® from 14" to 40"

Fluid Temperature:
With Remote Converter:
PFA, PTFE & Halar 311°F, (155°C)
Rubber 178°F, (80°C)
With Meter Mounted Converter:
PFA, PTFE & Halar 212°F, (100°C)
Rubber 178°F, (80°C)
Pressure Limits:
150 psi (10Bar) optional 300psi (20Bar)
Coil Power: Pulsed DC
Ambient Temperature: -4°F to 140°F, (-20°C to 60°C)
Pipe Spool Material: 316 Stainless Steel
Meter Housing Material: Carbon Steel welded

Flanges: Carbon Steel - Standard (ANSI B16.5 (
150 RF) 316 Stainless Steel - Optional
Meter Enclosure Classification: Nema 4
Optional: Submersible Nema 6P (Remote Amplifi
Required)
Junction Box Enclosure Protection:
(For Remote Converter Option) Powder coated di
cast aluminum, Nema 4
Cable Entries: 1/2" NPT Cord Grip
Optional Stainless Steel Grounding Rings:

Meter Size	Thickness (of one ring)
up thru 10"	.135"
12" to 20"	.187"

Magnetoflow® and Primo® are registered trademarks of Badger Meter, Inc. Halar® is a registered trademark of Ausimont U.S.A., Inc.

Please see our website at
www.badgermeter.com
for specific contacts.

Due to continuous research, product improvements and enhanceme
Badger Meter reserves the right to change product or system specificat
without notice, except to the extent an outstanding bid obligation ex

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-953
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Magnetoflow® Mag Meter	Model Magnetoflow Primo® (3.1 Electronics)	**Technical Brief**

GENERAL

Badger's Primo amplifier was specifically designed to be used with the entire line of Magnetoflow electromagnetic flow meters. This amplifier represents the culmination of years of research into mag meter signal processing and includes the latest developments in microprocessor signal conditioning technology. The advanced design of the unit allows the accuracy of the detector to be better than .25% and the flow range better than 300:1. The Primo amplifier can be used as an integral part of the detector or it can be mounted remotely when necessary. The Primo electronics are housed in a NEMA 4X aluminum powder coated enclosure with easy access to all wiring and programming functions.

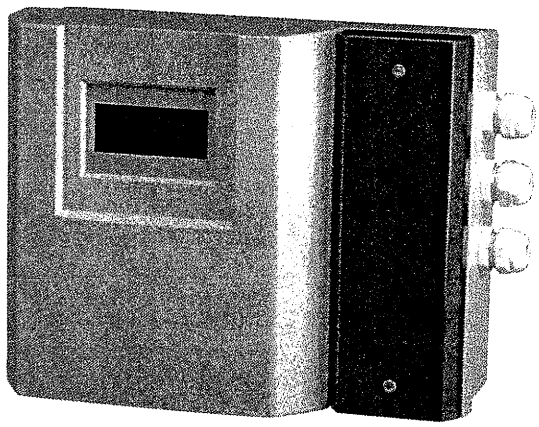
OPERATION

As the analog signal is received from the detector, the Primo unit amplifies the signal and converts it into digital information. At the processor level, the signal is analyzed through a series of sophisticated software algorithms and after separating it from electrical noise, it is converted into both analog and digital signals that are used to display rate of flow and totalization. In addition the processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Primo's 4 line, 16 character LCD display simultaneously indicates rate of flow, forward and reverse totalizers and diagnostic messages. It also serves to guide the user in simple English terms through the user-friendly programmable routines.

Programmable parameters of the Primo amplifier include: calibration factors, reset of totalizers, pulse value with auto decimal point position, selection of unit of measure, selection of flow direction, analog signal output, relay and open collector high and low flow alarm signals, low flow cut-off percent of flow and noise dampening factor.

APPLICATION

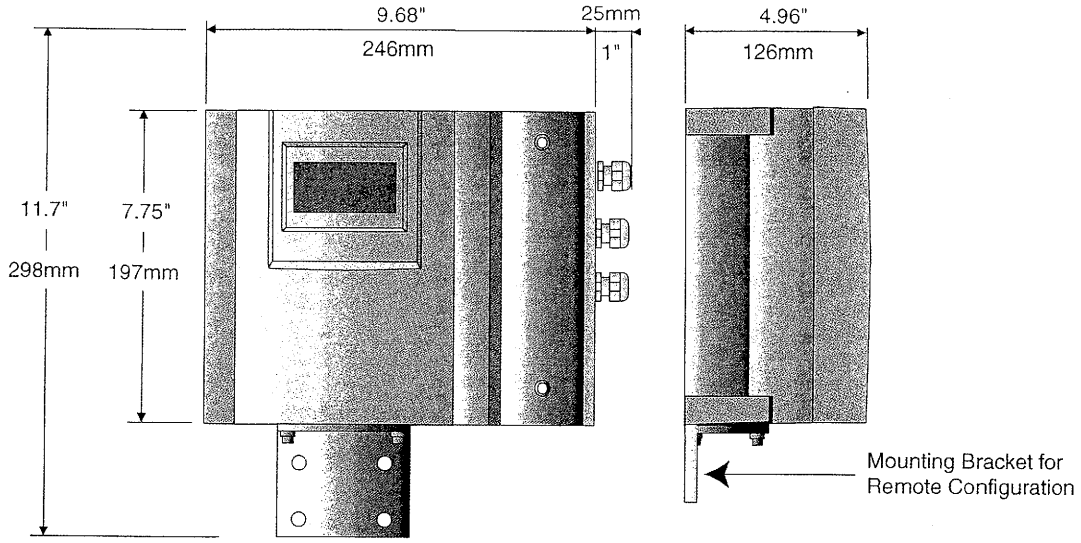
The Primo amplifier main function is to detect and condition the flow information from the electromagnetic detector. The unit is ideally suited for use in applications where the flow is continuous and indication of rate and totalization is required. Also, in applications where a minimum and/or a maximum flow rate must be kept and carefully monitored, the unit also provides pulse signals that can be fed to dedicated batch controllers, PLCs and other more specialized instrumentation.



Magnetoflow® Primo®

FEATURES

- Microprocessor based
- Large 4 line x 16 character back-lit LCD display
- User friendly programming procedure
- Digital and analog outputs
- NEMA 4X enclosure
- Sensor or remote wall mount
- Bidirectional flow sensing/totalization
- Automatic zero point stability
- Better than 0.1% repeatability
- Measures fluids with as low as 5.0 micromhos/cm conductivity
- Empty pipe detection



SPECIFICATIONS

Power Supply: 85-265 VAC, 45-65 Hz
Power Consumption: 20W
Accuracy: ± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from .1-1 fps.
Repeatability: <0.1%
Minimum Fluid Conductivity: 5.0 micromhos/cm
Processing: Microprocessor H8 (16 bit)
Flow Direction: Unidirectional or bidirectional, 2 separate totalizers (programmable)
Analog Outputs:

Current		Voltage
± 4 - ± 20mA < 800 Ω	or	± 2 - ± 10V < 1K Ω
± 2 - ± 10mA < 800 Ω	or	± 1 - ± 5V < 1K Ω
0 - ± 20mA < 800 Ω	or	0 - ± 10V < 1K Ω
0 - ± 10mA < 800 Ω	or	0 - ± 5V < 1K Ω

Ouput Frequency: Scaled Pulse output (open collector), Max 5Khz
Digital Outputs:
Voltage sourcing transistor, 24VDC, 100mA max
(3) AC Solid state relays, 48VAC, 0.5 amp max

Outputs: All outputs are short circuit safe.
Noise Dampening: Programmable from 1 to 6
Pulse Width: Programmable from 5ms to 500ms
Min-Max Flow Alarm: Programmable relay outputs 0 to 100% of flow
Units of Measure: Gallons, Ounces, Pounds, MGD, Liters, Cubic Meters, Cubic Feet, Acre Feet
Galvanic Separation: ≤ 500 volts
Low-flow-cutoff : Programmable 0-10% of max flow
Zero-point Stability: Automatic correction
LCD Display: 4 lines x 16 character back-lit alphanumeric; Displays (2) Totalizers, Flow Rate, Alarm Conditions
Programming: Three button manual
Housing: Cast aluminum, powder coated paint
Housing Rating: NEMA 4X
Mounting: Detector mount or remote wall mount (bracket supplied)
Cable Connection: 1/2" NPT Cord Grip
Ambient Temperature: -4 to 140° F (-20 to 60° C)
Serial Communication: RS232

Please see our website at
www.badgermeter.com
for specific contacts.

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

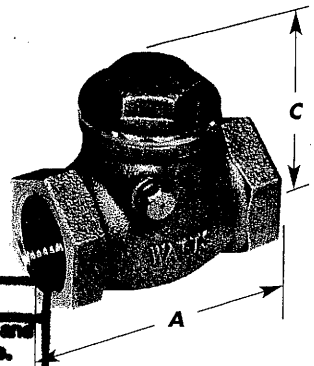
CHECK VALVES

SERIES CV 3/8" - 4" (10-100mm)
CVS† 1/2" - 3 (15-80mm)
BRONZE CHECK VALVES, TEE PATTERN

Used to prevent reverse fluid flow in commercial, industrial, steam, water, gas or oil lines.

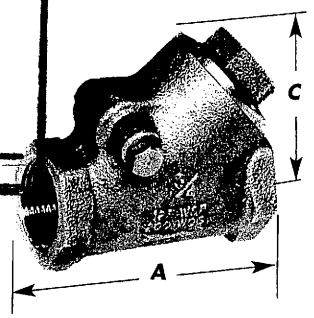
- Pressure Rating 125 psi (9 bars) WSP/200 psi (14 bars)WOG
- Bronze body
- Metal to metal seating
- 90° straight pattern

CV Threaded connections, **CVS** Solder ends †



SERIES CVY 3/8" - 2" (10-50mm)
CVYS† 1/2" - 2" (15-50mm)
BRONZE CHECK VALVES, WYE PATTERN

Used to prevent reverse flow in commercial and industrial lines.



MATERIALS

Body	Cast Bronze - ASTM B62
Cap	Cast Bronze - ASTM B62
Disc	Cast Bronze - ASTM B62
Hanger Pin	Brass rod - ASTM B16

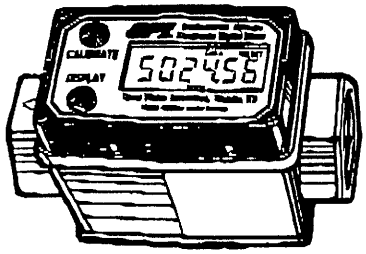
Size DN In.	Size DN mm	Ordering Code	Dimensions (approx.) A in.	A mm	C in.	C mm	Weight lbs.	Weight kgs.
Series CV - Tee pattern - threaded IPS connections - 125 WSP/200 WOG								
3/8	10	0700320	2 1/16	52	1 1/2	38	.05	.02
1/2	15	0700330	2 1/4	57	1 1/2	38	.53	.24
3/4	20	0700340	2 3/8	60	1 11/16	43	.67	.30
1	25	0700350	2 3/4	70	1 15/16	49	1.01	.46
1 1/4	32	0700360	3 1/4	83	2 3/16	55	1.54	.70
1 1/2	40	0700370	3 5/8	92	2 5/16	58	1.94	.88
2	50	0700380	4 1/4	108	2 7/8	73	3.21	1.46
2 1/2	65	0700390	5 1/2	140	3 1/2	89	6.00	2.72
3	80	0700400	5 7/8	149	3 3/4	95	7.90	3.58
4	100	0700410	7 1/4	184	4 1/2	114	13.00	5.90
Series CVS - Tee pattern - solder ends †								
1/2	15	0700430	2 1/2	64	1 1/2	38	.53	.24
3/4	20	0700440	2	50	1 3/4	44	.71	.32
1	25	0700450	3 1/2	89	1 7/8	48	.95	.43
1 1/4	32	0700460	4	100	2 1/16	52	1.54	.70
1 1/2	40	0700470	4 3/4	121	2 3/8	60	1.87	.85
2	50	0700480	5 1/4	133	2 3/4	70	3.20	1.45
2 1/2	65	0700490	6 3/8	162	3 1/2	89	5.80	2.63
3	80	0700500	7 3/16	183	3 3/4	95	7.60	3.44

Size DN In.	Size DN mm	Ordering Code	Dimensions (approx.) A in.	A mm	C in.	C mm	Weight lbs.	Weight kgs.
Series CVY - Wye pattern - threaded IPS connections - 125 WSP/200 WOG								
3/8	10	0700520	2 3/16	55	1 5/8	41	.62	.28
1/2	15	0700530	2 3/16	55	1 5/8	41	.62	.28
3/4	20	0700540	2 3/4	70	2	50	.88	.40
1	25	0700550	3 1/8	79	2 1/4	57	1.32	.60
1 1/4	32	0700560	3 3/4	95	2 11/16	68	2.00	.91
1 1/2	40	0700570	4 5/16	108	3 1/16	78	2.87	1.30
2	50	0700580	5 1/16	129	3 3/4	95	4.76	2.16
Series CVYS - Wye pattern - solder ends								
1/2	15	0700630	2 11/16	68	1 5/8	41	.60	.27
3/4	20	0700640	3 3/8	86	1 15/16	49	.82	.37
1	25	0700650	4 1/16	102	2 1/4	57	1.24	.56
1 1/4	32	0700660	4 3/4	121	2 5/8	67	1.87	.85
1 1/2	40	0700670	5 3/8	137	3 1/16	78	2.71	1.23
2	50	0700680	6 11/16	168	3 3/4	95	4.76	2.16

GPI®

GREAT PLAINS INDUSTRIES, INC.

"A Great Plains Ventures Subsidiary"



Model S100 Turbine shown with standard Computer Electronics, which are sold separately.

Industrial Grade Metering Products

Stainless Steel Turbine

Model S100

Technical Specifications

6/00 ML-1233-A

Flow Ranges		**Temperatures** (Turbine only without computer)		
Linear:	5 to 50 GPM (18.9 to 190 LPM)	Operational:	-40° to +250°F (-40° to +121°C)	
Extended:	2.5 to 50 GPM (9.5 to 190 LPM)	Storage:	-40° to +250°F (-40° to+121°C)	
Maximum Flow: 75 GPM (284 LPM)				
Fluid Velocity in Extended Range: 0.93-18.6 ft./sec. (0.28-5.7 m/sec.)		**Wetted Components**		
		Housing:	316 Stainless Steel	
Performance*		Journal Bearings:	Ceramic (96% Alumina)	
Linear Range:	10:1 @ ±1.5% of reading	Shaft:	Tungsten Carbide	
Extended Range:	20:1 @ ±5.0% of reading	Rotor and Supports:	PVDF	
Repeatability:	±0.1%	Retaining Rings: 316 Stainless Steel		
Maximum Pressure Drop in 10:1 Range:	10 PSIG (0.34 bar)	**Weight**		
Pressure Rating:	1,500 PSIG (103 bar)	Turbine only:		2.4 lbs.(1.1 kg)
Frequency Range:	45-475 Hz @ 5-50 GPM	Turbine with computer:		2.6 lbs.(1.2 kg)
Connections		**Shipping Weight**		
Inlet and Outlet:	1 inch female NPT or ISO	Turbine only:		2.6 lbs.(1.2 kg)
Wrench Flat Size:	1-5/8 in. (41mm)	Turbine with computer:		2.8 lbs.(1.3 kg)

- Field Replaceable Internal Parts
- High Accuracy
- Signal Output Capabilities
- Excellent Chemical Compatibility
- High Turndown Ratio
- Acccssories easily upgrade meter

All GPI turbines are Factory Mutual Approved and carry a Class 1, Division 1 Approval for hazardous environments.

FM APPROVED

CLASSIFIED C UL 80AL

GPI is a registered [illegible] of Great Plains Industries, Inc. U.S. [illegible] 4,700,579 [illegible] 5,046,370. [illegible] Patent P3478494.2-08 [illegible]

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details required for coordination with other equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and resubmit
Rejected

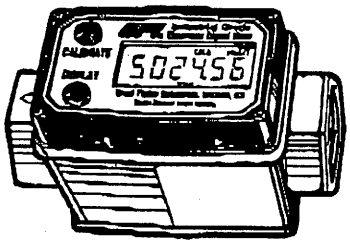
Department ENG.

Date 7/23/03

By [signature]

* Results determined with 1 centistoke stoddard solvent test fluid at 70°F (21°C).

GREAT PLAINS INDUSTRIES, INC.
"A Great Plains Ventures Subsidiary"

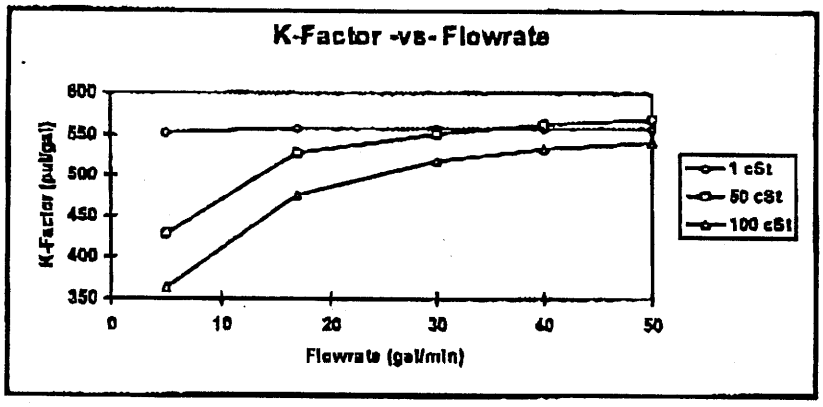


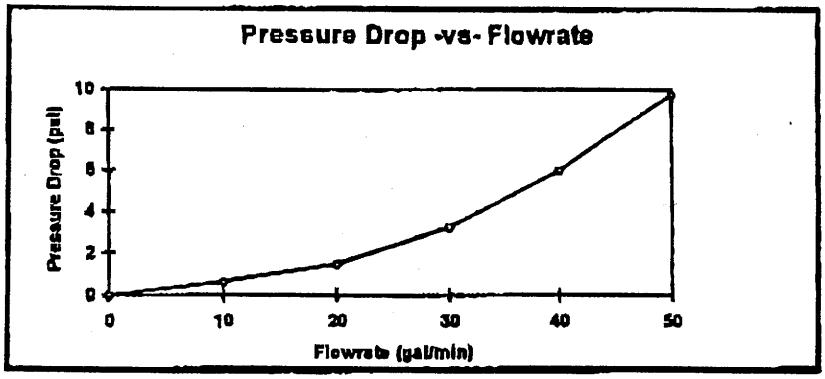
Industrial Grade Metering Products

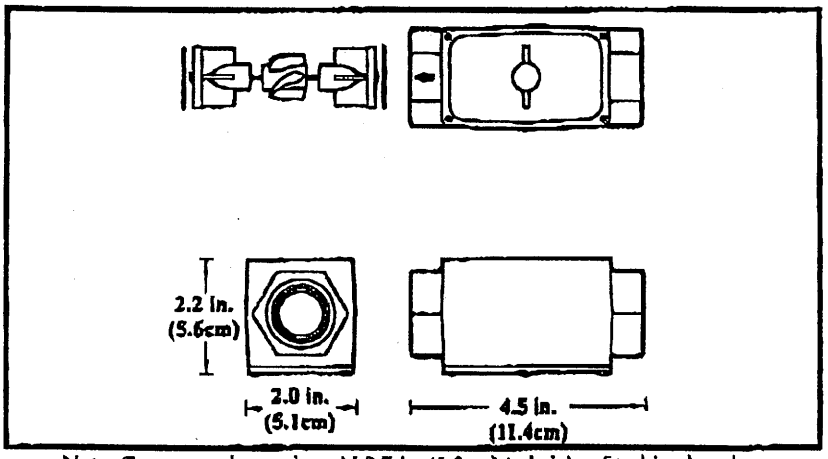
Stainless Steel Turbine

Model S100

6/00 ML-1233-8







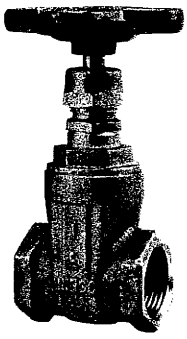
Note: Computer electronics add 0.7 in. (1.8cm) to height of turbine housing.

Class 125 Bronze Gate Valves

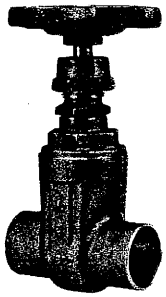
Screw-in Bonnet • Non-Rising Stem • Solid Wedge

Dezincification Resistant

125 PSI/8.6 Bar Saturated Steam to 353° F/178° C
200 PSI/13.8 Bar Non-Shock Cold Working Pressure•



T-113
Threaded

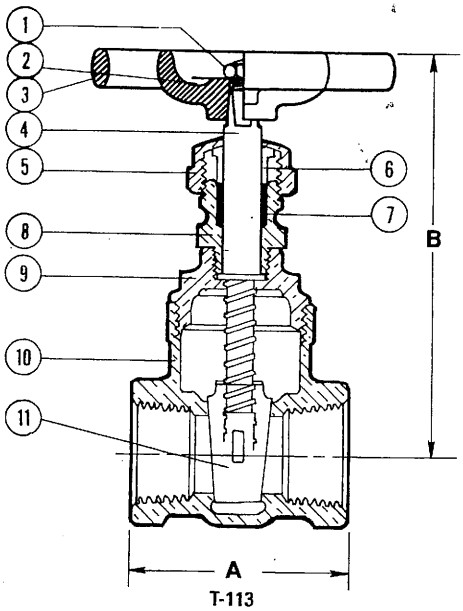


S-113
Solder

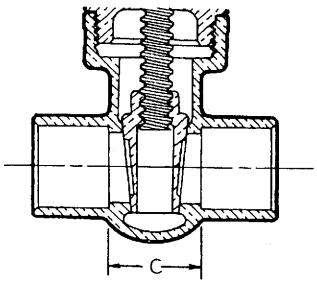
CONFORMS TO MSS SP-80

MATERIAL LIST

PART	SPECIFICATION
1. Handwheel Nut	Zinc Plated Steel with Clear Chromate
2. Identification Plate	Aluminum
3. Handwheel	a. Malleable Iron ASTM A 47 (T-113) b. Bronze (T-113-BHW) c. Bronze Cross (T-113-K)
4. Stem	Silicon Bronze ASTM B 371 Alloy C69400 or ASTM B99 Alloy C65100
5. Packing Nut	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
6. Packing Gland	Bronze ASTM B 62 or ASTM B 584 Alloy C84400 or Brass ASTM B 16
7. Packing	Aramid Fibres with Graphite
8. Stuffing Box	Bronze ASTM B 62
9. Bonnet	Bronze ASTM B 62
10. Body	Brass ASTM B 00
11. Wedge	Bronze ASTM B 62



T-113
NPT x NPT



S-113
C x C

NON-BURIED APPLICATION ONLY

SUBMITTAL REVIEW
Review is for general conformity with the design concept and is limited to requirements called for by the contract documents. Contractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.
X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected
Date 6/27/03 Department ENG
By mw Mallet

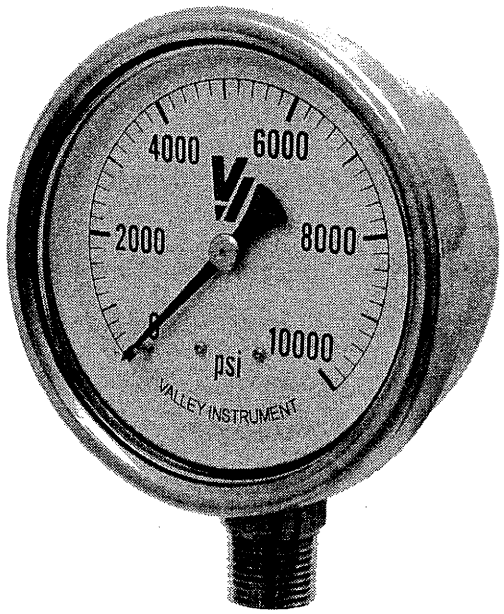
DIMENSIONS—WEIGHTS—QUANTITIES

Size In.	Size mm.	Dimensions A In.	A mm.	B In.	B mm.	C In.	C mm.	T-113 Lbs.	T-113 Kg.	S-113 Lbs.	S-113 Kg.	Master Ctn. Qty.
¼ †	8	1.69	43	3.38	86	x	x	0.74	0.33	x	x	50
⅜ †	10	1.69	43	3.38	86	.69	18	0.71	0.32	0.65	0.29	50
½ †	15	1.94	49	3.63	92	.75	19	0.82	0.37	0.67	0.31	50
¾	20	2.06	54	3.91	99	.88	22	1.10	0.50	0.99	0.45	50
1	25	2.44	62	4.69	119	1.00	25	1.82	0.82	1.60	0.72	30
1¼	32	2.63	67	5.22	133	1.19	32	2.40	1.09	2.25	1.02	20
1½	40	2.88	72	6.25	159	1.25	33	3.51	1.59	3.17	1.44	10
2	50	3.06	78	7.06	179	1.31	34	4.93	2.24	4.60	2.09	10
2½	65	4.13	105	8.41	224	1.81	46	9.96	4.52	8.78	3.98	5
3	80	4.50	114	10	254	1.94	49	14.40	6.53	12.84	5.82	4

† No packing gland, packing only in these sizes.
x Not available this size.

Freezing Weather Precaution – Subsequent to testing a piping system, valves should be in an open position to allow complete drainage.

• For detailed Operating Pressure, refer to Pressure Temperature Chart on page 107.



Model 58
All Stainless Gauges
Welded Connection
Field Repairable
(Single Scale)

SUBMITTAL REVIEW

limited ... design concept and is
contra...
and do...
and fo...
tion or ...

X

Date 6/27/03 Department ENG

By

4" Case Only

Bottom Mount Only

These gauges are designed for use with any medium not corrosive to stainless steel. Liquid-filled gauges are recommended for reducing shock caused by pressure fluctuations or vibration.

FEATURES

MOVEMENT:	Stainless Steel
BOURDON TUBE:	316 Stainless Steel
POINTER:	Black enameled aluminum
DIAL:	White aluminum
WINDOW:	Polycarbonate
CASE MATERIAL	304 Stainless steel
BEZEL	304 Stainless steel, Bayonet type.
CONNECTION MATERIAL	316 Stainless steel
CONNECTION SIZE	1/2" MNPT Standard
ACCURACY:	ASME/ANSI B40.1 Grade 1A (1%)

STANDARD RANGES

Standard gauge scales - PSI Only

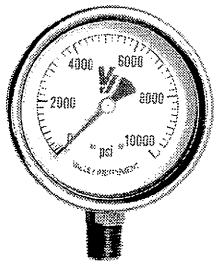
STANDARD DIAL RANGES	AVAILABILITY	GRADUATION	
PSI	4"	Major	Minor
0-30" VAC	✔	5	.5
0-15 psi	✔	2	.2
0-30 psi	✔	5	.5
0-60 psi	✔	10	1
0-100 psi	✔	20	2
0-160 psi	✔	20	2
0-200 psi	✔	50	5
0-300 psi	✔	50	5
0-400 psi	✔	100	10
0-600 psi	✔	100	10
0-1000 psi	✔	200	20
0-1500 psi	✔	200	20
0-2000 psi	✔	500	50
0-3000 psi	✔	500	50
0-5000 psi	✔	1000	100
0-10000 psi	✔	2000	200
0-15000 psi	✔	2000	200
0-20000 psi	✔	2000	200

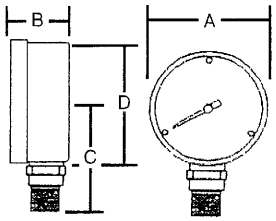
PRICING AND OPTIONS - (Stock)

4" CASE	..... $116.00

CASE STYLES AND DIMENSIONS

BOTTOM MOUNT Style 1





SIZE	A	B	C	D	E
4"	4.344"	1.828"	3.391"	3.970"	n/a

ORDERING INFORMATION

To determine the ordering number, use the following information

Example - 4158GXX200 = 4", 1/2" Btm Mt., All Stainless - Field Repairable, Glycerin-filled, Stainless Case, 200 PSI

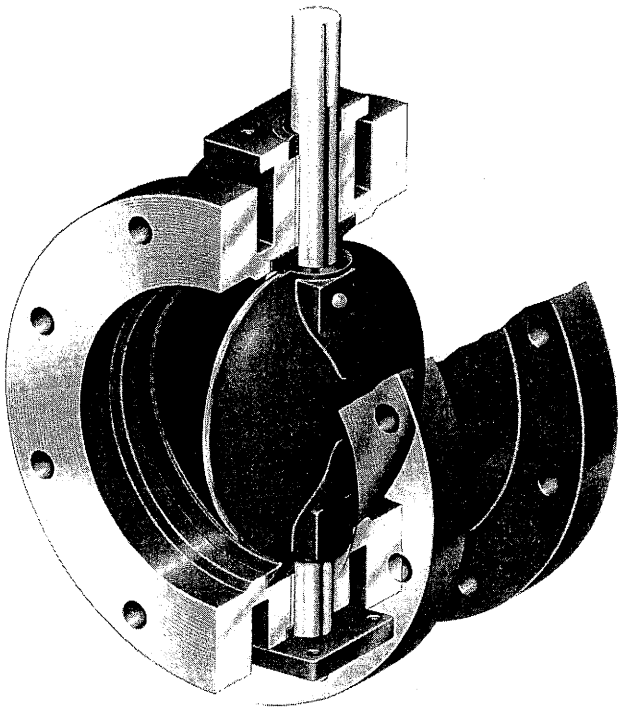
4	1	58	G	X	X	200	
1st Digit	2nd Digit	3rd & 4th Digits	5th Digit	6th Digit	7th Digit	Range	Suffix
Dial Size	Case Style	Model	Fill Material	Case Material	Wetted Parts	PSI	Options
4 = 4"	1 = Bottom	58 = Stainless Field Repairable	D - Dry G - Glycerin S - Silicone F - Florolube	X = Stainless	X = Stainless	SEE RANGE CHART	Custom Logo Color Dial Special Dial Etc.

MUELLER LINESEAL III Butterfly Valve Features

- ❑ CHEVRON V-TYPE PACKING--
  is self-adjusting, long lasting and should never need replacement because quarter-turn valve operation causes little or no wear. Packing bears on turned, ground and polished stainless steel.

- ❑ CORROSION RESISTANT SHAFT--
  is constucted of type 304, 18-8 stainless steel. Shaft is one-piece, through-shaft construction sized to meet or exceed requirements of AWWA Standard C504 for Class 150B service.

- ❑ HEAVY DUTY CAST IRON BODY--
  is extra heavy with flanges fully faced and drilled per ANSI B16.1 Class 125 Standard for cast-iron flanges. Other ends available include integrally cast mechanical joint, slip-on (for DI and PVC C900), and grooved style. Operator mounting trunnion is machined and drilled for four-bolt connection.



- ❑ SELF-LUBRICATING BEARINGS--
  are liberally sized, chemically inert nylon bearings that are self-lubricating and should outlast the life of the pipeline.

- ❑ STREAMLINED DISC--
  has lens-shaped design to minimize pressure drop and turbulence. Full open valve creates no more friction loss than a 45 elbow. Disc is secured to the shaft by stainless steel pins sized to transmit torques required and withstand stresses imposed under severe operating conditions. Disc is cast iron ASTM A-126 Class B with 316 stainless steel disc edge.

- ❑ ELASTOMERIC BODY SEAT--
  is made of a special rubber compound (Buna N) that is bonded to the body by a patented process. The seat cannot be torn from the body under normal pipeline conditions. The precision molding process also ensures that the disc-seat indentation cannot cause excessive wear or abrasion upon closing.

- ❑ TAMPER-PROOF DISC CENTERING--
  provided by precision molded flats in the bonded seat at the body trunnion mate with machined flats on the disc to prov[illegible]de tamperproof centering of the disc in the body. Positive disc alignment, without p[illegible] long seat life.

Need position locking handle

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

	No Exceptions Taken
X	Furnish as Corrected
	Amend and Resubmit
	Rejected

Date 6/27/03 Department EMG

By [illegible]

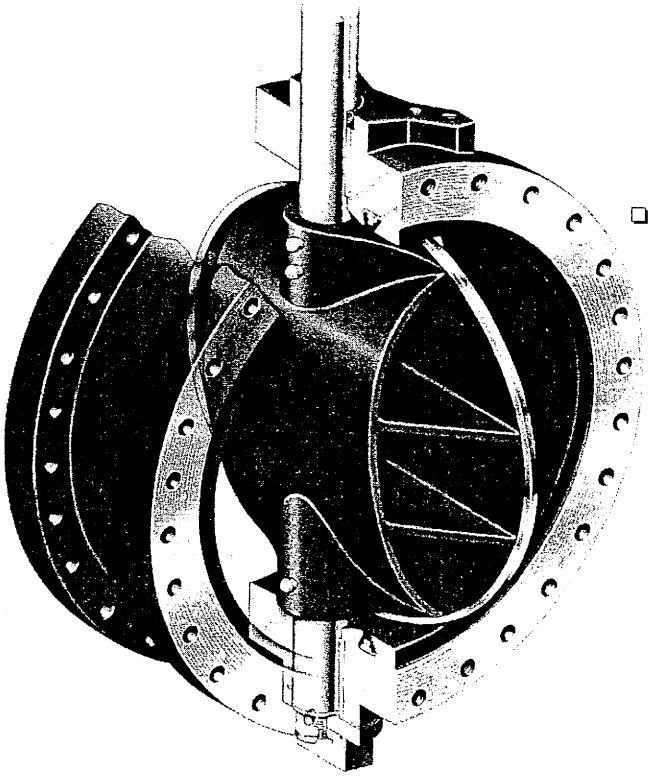
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

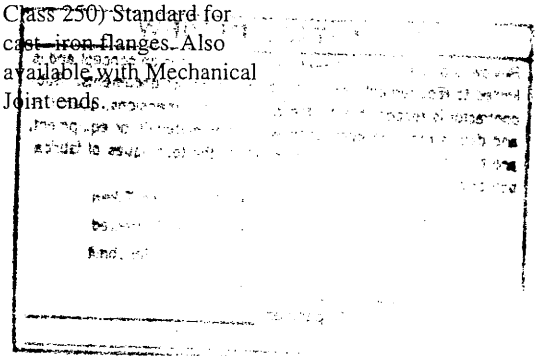
MUELLER® 24"* - 48"** LINESEAL III® AND 6"*-48"** LINESEAL XP BUTTERFLY VALVES

Rev. 12-01

MUELLER LINESEAL III and LINESEAL XP Butterfly Valve Features

- ❑ CORROSION RESISTANT SHAFT-- is constucted of ASTM A-276 Type stainless steel. Two-piece, stub-type shafts are sized per AWWA Standard C504, Class 150B or Class 250.
- ❑ CHEVRON V-TYPE PACKING-- is self-adjusting packing in top trunnion of valve body where shaft protrudes, includes nylon retainer.
- ❑ STRONG DISC AND SHAFT CONNECTIONS-- with generously sized stainless steel pins designed to transmit torques required and withstand stresses imposed under severe operating conditions.
- ❑ PRESET TWO-WAY THRUST BEARING ASSEMBLY-- is preset at factory. On valves 30" and larger, assembly consists of stainless steel stud fastened to the bottom of the valve shaft. Stud extends beyond the bottom cover. Thrust collar is threaded to the stud and pinned. On 24" size Lineseal III and 6" to 24" Lineseal XP, thrust collar is pinned to shaft and adjustment provided by bronze spacers. Thrust collar cavity is packed with grease and fully gasketed to prevent leakage.
- ❑ HEAVY DUTY ASTM A-126 CAST IRON BODY-- is extra heavy; on flange-end bodies, flange drilling per ANSI B16.1 Class 125 (or Class 250) Standard for cast iron flanges. Also available with Mechanical Joint ends.





- ❑ SELF-LUBRICATING, SLEEVE-TYPE BEARINGS-- are used in both trunnions of the valve body. Teflon lined with special non-metallic backing. Provide electrical insulation between disc and shaft to prevent galvanic corrosion. Lower coefficient of friction reduces operating torque requirements.
- ❑ FLOW-THROUGH DISC*-- provides less pressure drop in full-open position than conventional disc shapes. (On 24" size Lineseal III and 6" to 24" Lineseal XP the arch side of disc is closed and the flat side is open, forming a slightly concave surface.) Disc structure has no internal cores that can shift during casting, no hollow chambers that can collect water, freeze and fracture the disc. Disc edge has stainless steel spherically shaped seating surface. Ductile iron ASTM A-536 is used for 30"-48" Lineseal III and for 6"-8" and 24"-48" Lineseal XP. (Cast iron ASTM A-48 Class 40 is used for 24" size Lineseal III and for 10"-20" Lineseal XP.)
- ❑ ELASTOMERIC SEAT-- is made of a special rubber compound (Buna N) that seals a full 360 against a stainless steel spherical disc edge. Unique grooved-seal design, coupled with the wide spherically shaped seating edge of the disc, allows greater disc closure tolerance (up to 1 off center in closed position without leakage). Seat is mechanically retained in body without metal hardware by a cast epoxy compound that ensures the seat conforms to the exact radius of the disc with uniform contact pressure.

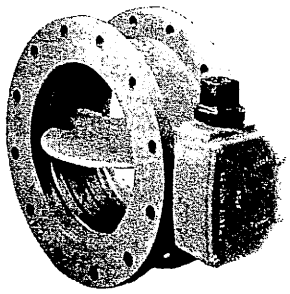
* Note: 6" - 24" disc is slightly modified, non flow-through disc design.

** Contact your Mueller representative for valves sizes larger than 48".

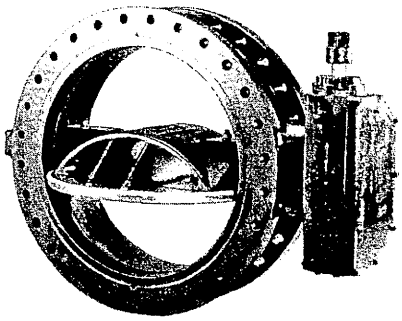
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

BUTTERFLY VALVES 4" - 48"*

- Catalog number--
  3211-6 Flanged Ends
  3211-20 Mechanical joint ends
  (with mechanical joint unassembled accessories)
  3211-23 Mechanical joint ends
  (without mechanical joint accessories)
  Sizes--4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 30", 36", 42", 48", 54"-72"*
  3211-16 Flanged by mechanical joint ends
  (with mechanical joint unassembled accessories)
  3211-19 Flanged by mechanical joint ends
  (without mechanical joint unassembled accessories)
  Sizes--6", 8", 10", 12", 14", 16"
  3211-41 Flanged by slip-on
  Sizes--4", 6", 8", 10", 12"
  3211-38 Slip-on by slip-on
  Sizes--4", 6", 8", 10", 12", 16Ó



- Meets or exceeds all applicable requirements of ANSI/AWWA C504 Standard Class 150B; NSF 61 certified
- Buried service valves: I.D. and O.D. coated with 5 mils Asphalt Varnish
- Above ground valves (ordered with either a handwheel, position indicator on the actuator, or lever): coated with 3 mils Tnemec Series 140F Pota-Pox Plus primeron the valve O.D. and 5 mils Asphalt Varnish on the I.D. as standard; meets AWWA C-504 standards.
- Seat-in-body design reduces seat failure due to corrosive buildup in the valve and pipeline
- Through-disc pinning provides a tight disc-to-shaft pin connection, greatly reducing the possibility of loosening through vibration
- Disc edge is 316 Stainless Steel
- Symetrical lens-shaped disc for higher Cv and lower head loss
- Nonmetallic bearings prevent galvanic corrosion and provides lower coefficient of friction
- Cheveron "V" type packing is self-adjusting to last the life of the valve



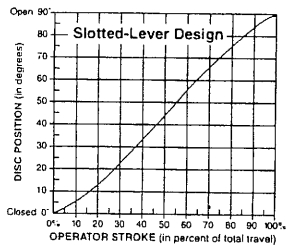
Options

- MDT Actuatorwith handwheel or chainwheel and position indicator
- MDT Actuator with cylinder actuator (also available with manual override, handjack and 4-way solenoid valve)
- Hand lever for 4"-10" valves
- 200 psi test
- Extension stems (see page 10.71)
- Expoxy interior and/or exterior
- Holiday testing
- Mueller ground position indicator

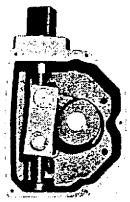
Standard Buried Service Actuators

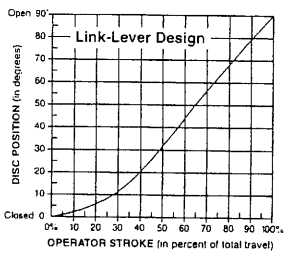
Valve size	Actuator	Number of turns
4" - 12"	MDT-2	32
14" - 20"	MDT-3	30
16" - 24"	MDT-4	40
20" - 30"	MDT-5	136
30" - 36"	MDT-5S	136
36" - 48"	MDT-6	215
36" - 48"	MDT-7	492

Slotted-Lever (4"-12")



Link-Lever (14"-48")





* Contact your Mueller representative for valve sizes larger than 48".

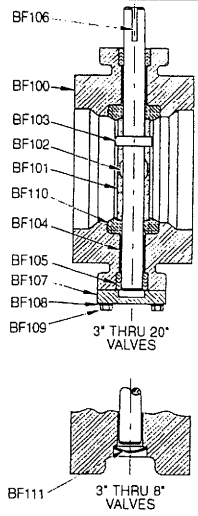
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

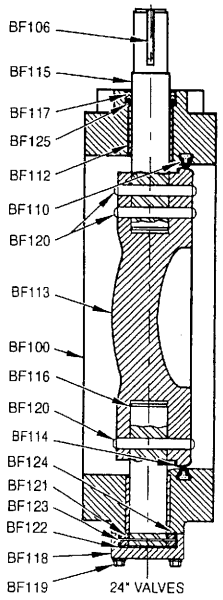
MUELLER® LINESEAL III® BUTTERFLY VALVES 4"-48"* CLASS 150B-PARTS

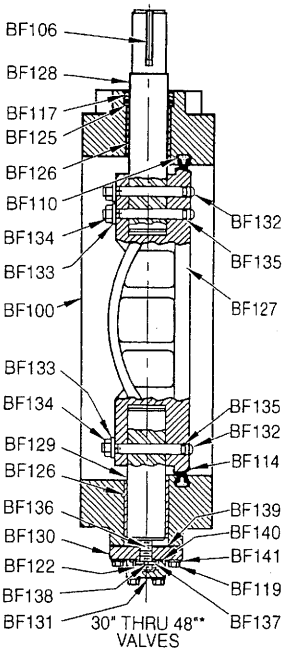
Lineseal III Butterfly Valve Replacement Parts

Catalog Part No.	Description	Material
BF100	Body	Cast iron ASTM A126 CL. B
BF101	Disc:**	Cast Iron ASTM A126, Class B with 316 Edge
BF102	Shaft	Stainless Steel 18-8 Type 304 ASTM A-276
BF103	Squeeze pin	Stainless Steel 18-8 Type 304 ASTM A-276
BF104	Bearing	Nylatron GS
BF105	Packing	Chevron V-Type
BF106	Key	Carbon Steel C-1045
BF107	Cover	Cast Iron ASTM A-48 Class 40
BF108	Lockwasher	Carbon Steel
BF109	Cap screw	Steel SAE Gr. 2
BF110	Seat	Buna-N
BF111***	Exp. plug	Stainless Steel 18-8 Type 304 ASTM A-276
BF112	Bearings	Teflon Lined, Filament Wound, Reinforced Plastic, Fiberglass Backed
BF113	Disc	Cast Iron ASTM A-48 Class 40
BF114	Disc edge	Stainless Steel Type 316 ASTM A-240
BF115	Top stub shaft	Stainless Steel Type 304 ASTM A-276 Stainless Steel Type 316 ASTM A-276 400 Monel ASTM B-164 Class A
BF116	Bottom stub shaft	Stainless Steel Type 304 ASTM A-276 Stainless Steel Type 316 ASTM A-276 400 Monel ASTM B-164 Class A
BF117	Packing	Buna-N
BF118	Bottom cover	Cast Iron ASTM A-48 Class 40
BF119	Cap screws	Carbon Steel
BF120	Squeeze pins	Stainless Steel Type 304 ASTM A-479
BF121	Thrust collar	Stainless Steel Type 420
BF122	Thrust collar shims	Bronze
BF123	Spring pin	Stainless Steel Type 420
BF124	O-ring	Buna-N
BF125	Packing retainer	Nylon
BF126	Bearings	Duralon
BF127	Disc	Ductile Iron ASTM A-536 Grade 65-45-12
BF128	Top stub shaft	Stainless Steel Type 304 ASTM A-276
BF129	Bottom stub shaft	Stainless Steel Type 304 ASTM A-276
BF130	Bottom cover	Cast Iron ASTM A-126 Class B
BF131	Bottom cover cap	Cast Iron ASTM A-126 Class B
BF132	Taper pins	Stainless Steel Type 630 ASTM A-564 Cond. H-1150
BF133	Lockwashers	Stainless Steel Type 304
BF134	Hex nuts	Stainless Steel Type 304
BF135	O-rings	Buna-N
BF136	Thrust bearing stud	Stainless Steel Type 304
BF137	Thrust collar	Bronze ASTM B-505 Alloy C93200
BF138	Dowel pin	Alloy Steel
BF139	Bottom cover gasket	Blended Fiber, Cured Nitril Binder
BF140	O-ring	Buna-N
BF141	Loctite	Loctite

* Contact you Meuller representative for sizes larger than 48".
**4" is ASTM A743 CF8M Stainless Steel.
***This plug is for 3"-8" sizes only.

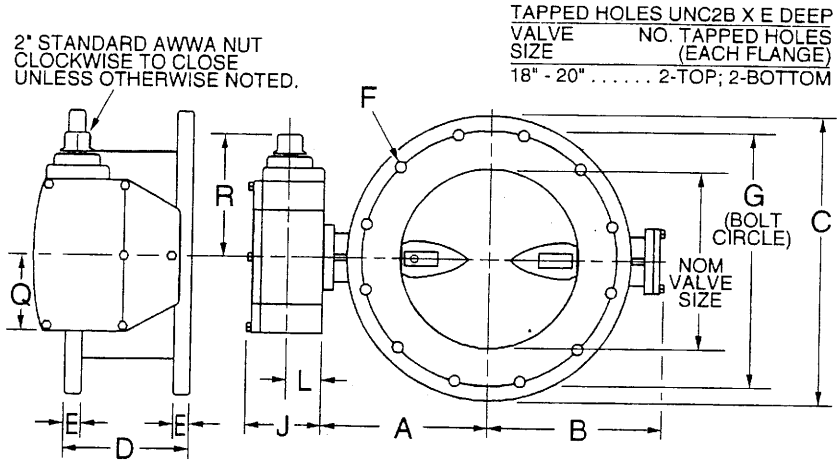




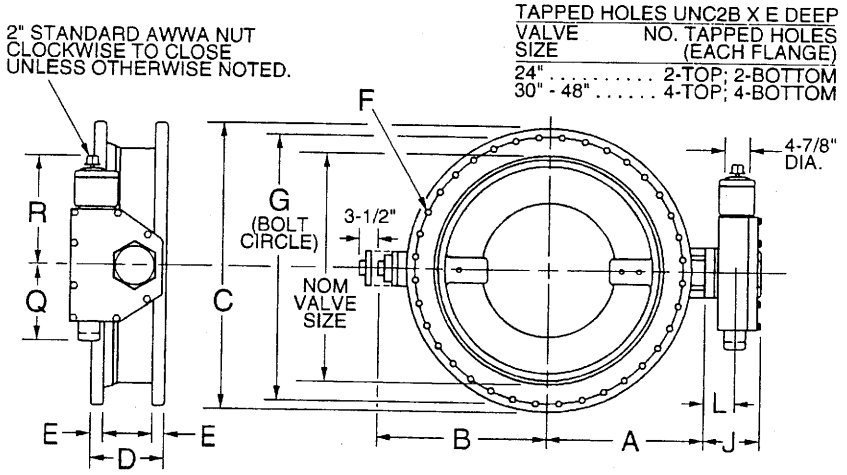


FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

Dimensions - for Mueller Lineseal III Butterfly Valves Flanged Ends, 4" - 20" Sizes.



Dimensions - for Mueller Lineseal III Butterfly Valves Flanged Ends, 24" - 48" Sizes.



Dimensions

Dimension +	Nominal size													
	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"
A	5-1/2	6-1/2	7-3/4	9	10-1/2	11-7/8	13-1/2	14-3/8	16	18-5/8	21-1/2	25-7/16	29-7/8	34-1/16
B	3-1/2	5-1/8	6-1/2	9-7/8	11-5/8	12-3/4	14-3/8	15-1/4	16-7/8	18-3/8	24-3/16	28-1/16	32-11/16	34-7/8
C	9	11	13-1/2	16	19	21	23-1/2	25	27-1/2	32	38-3/4	46	53	59-1/2
D ***	5	5	6	8	8	8	8	8	8	8	12	12	12	15
E	15/16	1	1-1/8	1-3/16	1-5/16	1-3/8	1-7/16	1-9/16	1-11/16	1-7/8	2-1/8	2-3/8	2-5/8	2-3/4
F (number and size of holes)	8---5/8	8---3/4	8---3/4	12---7/8	12---7/8	12---1	16---1	16---1-1/8	16---1-1/8	20---1-1/4	28---1-1/4	32---1-1/2	36---1-1/2	44---1-1/2
G	7-1/2	9-1/2	11-3/4	14-1/4	17	18-3/4	21-1/4	22-3/4	25	29-1/2	36	42-3/4	49-1/2	56
J	4-3/8	4-3/8	4-3/8	4-3/8	4-3/8	5-3/16	5-3/16	5-15/16	5-15/16	5-15/16	7-13/16	8-13/16	10-7/16	10-7/16
L	2	2	2	2	2	2-7/16	2-7/16	2-13/16	2-13/16	2-13/16	3-13/16	4-5/16	5-7/16	5-7/16
Q	4-1/4	4-1/4	4-1/4	4-1/4	4-1/4	5-3/8	5-3/8	6-3/4	6-3/4	6-3/4	10	15-15/16	18-5/8	18-5/8
R	7-5/8	7-5/8	7-5/8	7-5/8	7-5/8	9-1/4	9-1/4	10-1/2	10-1/2	10-1/2	17	19-11/16	26-1/2	26-1/2
Turns to open	32	32	32	32	32	30	30	40	40	40	44	136	215	215
Weight +	60	81	118	201	270	377	456	588	678	1029	1874	2735	3690	4340

Other sizes available upon request.
** Also available in FL.xFL. 30"-72" sizes: Class 75A, 75B, 25A, 25B.
*** ±1/16" for 10" valves, and ±1/8" for 12" - 48" valves per Flange Standard ANSI B16.1.
+ All dimensions are in inches. All weights are in pounds and are approximate.

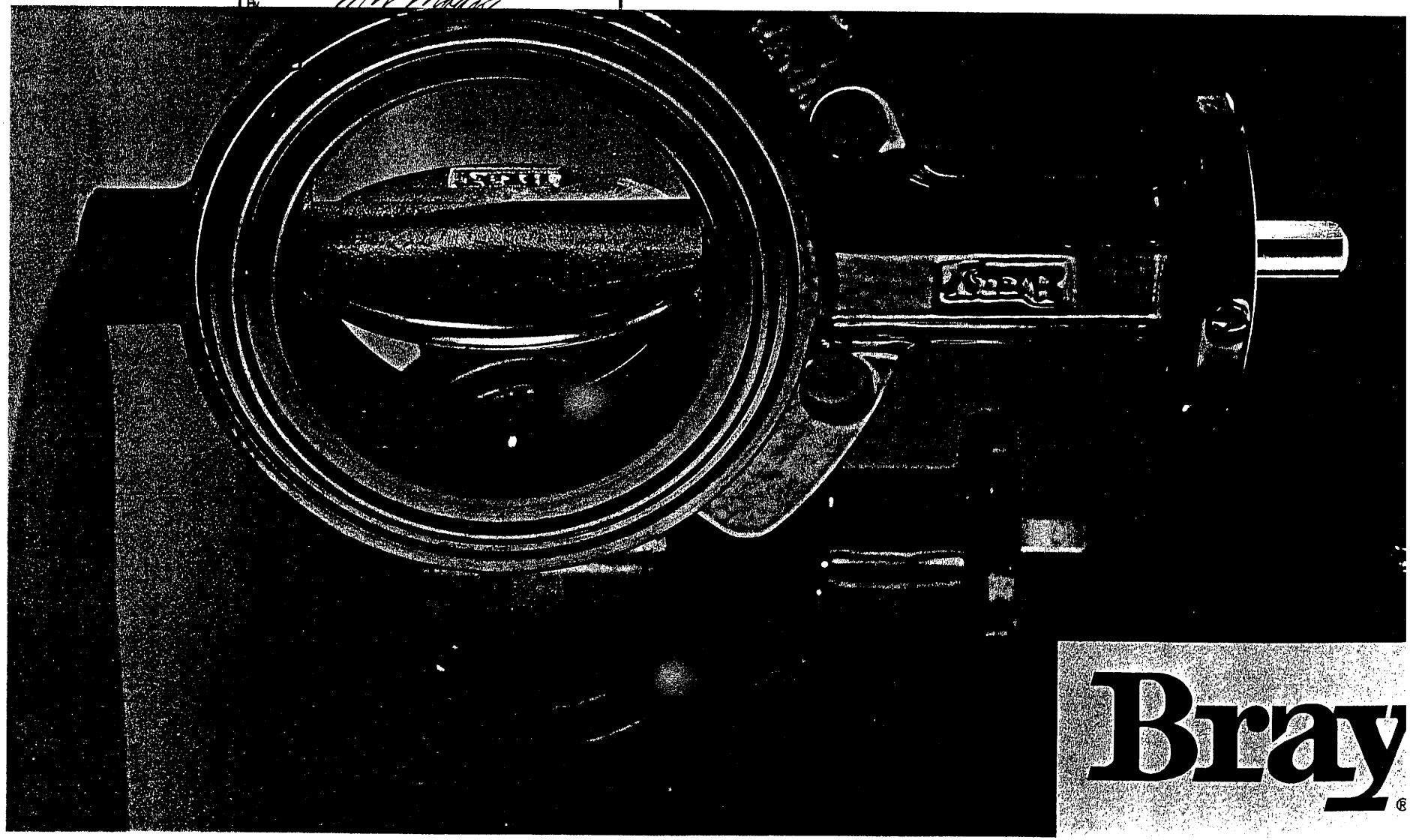
FOR ORDERING INSTRUCTIONS SEE PAGES 11.14 THROUGH 11.16

limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

____ No Exceptions Taken
_X_ Furnish as Corrected
____ Amend and Resubmit
____ Rejected

Date 6/27/03 Department ENG
By

Need Position locking handle



The High Performance Company

Bray®

BUTTERFLY VALVES

RESILIENT SEATED

SERIES 30/31 Wafer/Lug

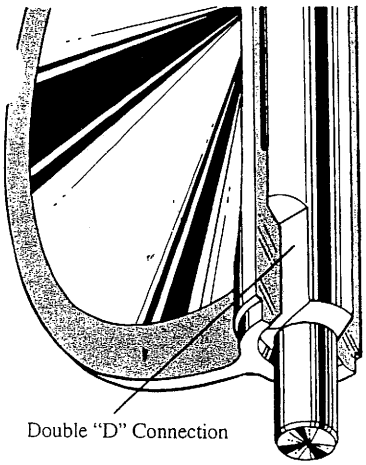
2" - 20" (50mm-500mm)

SERIES 30

2"–20" (50mm–500mm)
Bray® Controls is proud to offer a high quality line of butterfly valves to meet the requirements of today's market. Combining years of field application experience, research and development, Bray has designed many unique features in the Series 30/31 not previously available. The results are longer service life, greater reliability, ease of parts replacement and interchangeability of components.

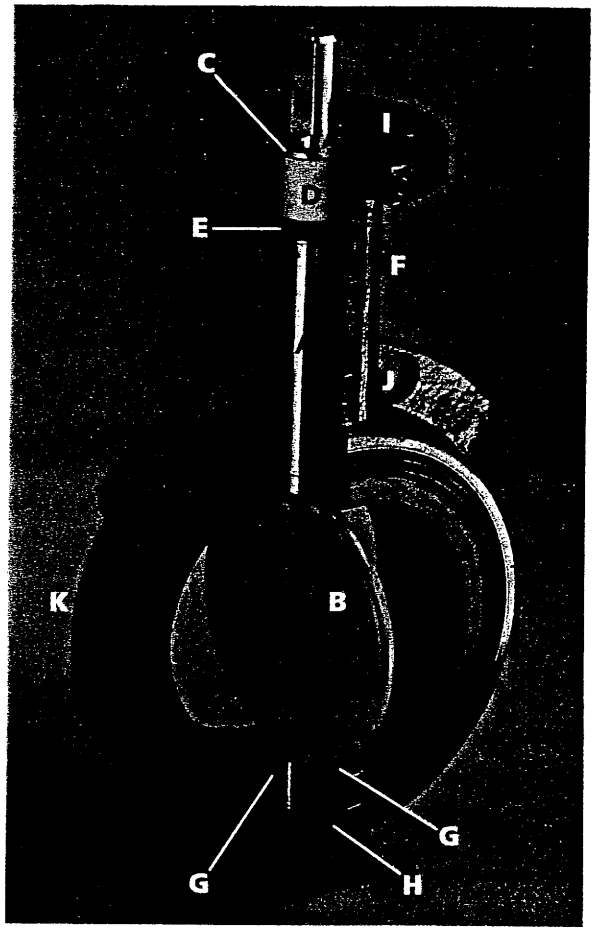
DISC AND STEM CONNECTION

(**A**) Features a high-strength through stem design. The close tolerance, double "D" connection that drives the valve disc is an exclusive feature of the Bray valve. It eliminates stem retention components being exposed to the line media, such as disc screws and taper pins, which commonly result in leak paths, corrosion, and vibration failures. Disc screws or taper pins, due to wear and corrosion, often require difficult machining for disassembly. Disassembly of the Bray stem is just a matter of pulling the stem out of the disc. Without fasteners obstructing the line flow, the Series 30/31 C_V values are higher than many other valves, turbulence is reduced, and pressure recovery is increased. The stem ends and top mounting flange are standardized for interchangeability with Bray actuators.



Double "D" Connection

DISC (**B**) Casting is spherically machined and hand polished to provide a bubble-ght shut off, minimum torque, and ɔnger seat life. The disc O.D. clearance is designed to work with all standard piping.



STEM BUSHING (D)

Non-corrosive, heavy duty acetal bushing absorbs actuator side thrusts.

STEM SEAL (E)

Double "U" cup seal design is self-adjusting and gives positive sealing in both directions. Prevents external substances from entering the stem bore.

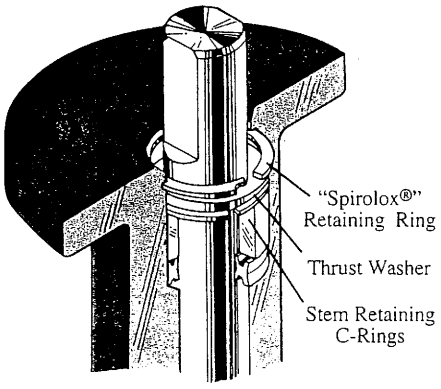
NECK (**F**) Extended neck length allows for 2" of piping insulation and is easily accessible for mounting actuators.

PRIMARY AND SECONDARY SEALS (G)

The Primary Seal is achieved by an interference fit of the molded seat flat with the disc hub. The Secondary Seal is created because the stem diameter is greater than the diameter of the seat stem hole. These seals prevent line media from coming in contact with the stem or body.

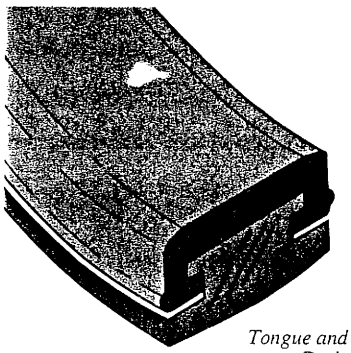
STEM RETAINING ASSEMBLY (C)

The stem is retained in the body by means of a unique Stainless Steel "Spirolox®" retaining ring, a thrust washer and two C-rings, manufactured from brass as standard, stainless steel upon request. The retaining ring may be easily removed with a standard hand tool. The stem retaining assembly prevents unintentional removal of the stem during field service.



BRAY UNIQUE SEAT DESIGN (H)

One of the valve's key elements is Bray's unique *tongue and groove* seat design. This resilient seat features lower torque than many valves on the market today and provides complete isolation of flowing media from the body. The tongue-and-groove seat to body retention method is superior to traditional designs, making field replacement simple and fast. The seat is specifically designed to seal with slip-on or weld-neck flanges. The seat features a molded O-ring which eliminates the use of flange gaskets. An important maintenance feature is



Tongue and Groove Design

*"Spirolox®" designation is a registered trademark of Kaydon Ring and Seal, Inc.

that all resilient seats for Bray butterfly valves Series 20, 21, 30, 31 and 34 are completely interchangeable.

ACTUATOR MOUNTING FLANGE AND STEM CONNECTION (I)
Universally designed to ISO 5211 for direct mounting of Bray® power actuators and manual operators.

FLANGE LOCATING HOLES (J)
Provide quick and proper alignment during installation.

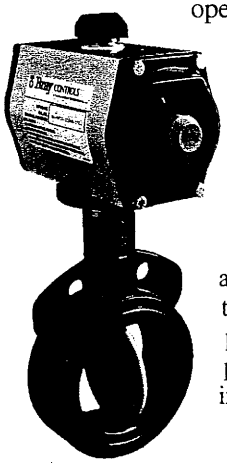
BODY (K) One-piece wafer or lug style. Polyester coating for excellent corrosion resistance. Bray valve bodies meet ANSI 150 pressure ratings for hydrostatic shell test requirements.

DESIGN FEATURES

Bray's Series 30 valve is a wafer version with flange locating holes, and the Series 31 is the companion lug version for dead-end service and other flange requirements. All Bray valves are tested to 110% of full pressure rating before shipment.

A major design advantage of Bray valve product lines is international compatibility. The same valve is compatible with most world flange standards – ANSI Class 125/150, BS 10 Tables D and E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10. In addition the valves are designed to comply with ISO 5752 face-to-face and ISO 5211 actuator mounting flanges. Therefore, one valve design can be used in many different world markets.

Due to a modular concept of design, all Bray® handles, manual gear operators and pneumatic and electric actuators mount directly to Bray valves. No brackets or adapters are required.



Bray interchangeability and compatibility offers you the best in uniformity of product line and low-cost performance in the industry today.

POLYESTER COATING CORROSION PROTECTION
Bray's standard product offers valve bodies with a polyester coating, providing excellent corrosion and wear resistance to the valve's surface. The Bray polyester coating is a hard, gloss red finish.

Chemical Resistance – resists a broad range of chemicals including: dilute aqueous acids and alkalies, petroleum solvents, alcohols, greases and oils. Offers outstanding resistance to humidity and water.

Weatherability – outdoor tested resistant to ultra-violet radiation.

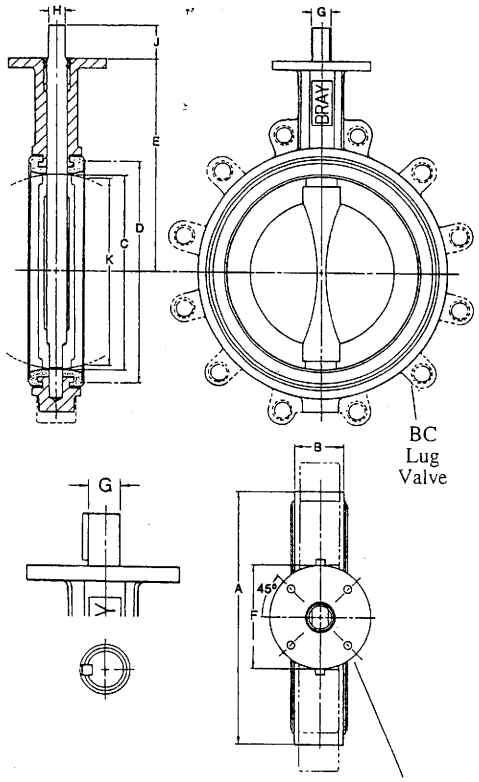
Abrasion Resistance – excellent resistance to abrasion.

Impact Resistance – withstands impact without chipping or cracking.

NYLON 11 COATING
Optionally available for valve bodies where outstanding protection and performance is needed. A thermoplastic produced from a vegetable base, this coating is inert to fungus growth and molds. Nylon 11 is *USDA Approved*, as well as certified to ANSI/NSF 61 for water service.

Corrosion Resistance – superior resistance to a broad range of chemical environments. Salt spray tested in excess of 2,000 hours and seawater immersion tested for over 10 years without corrosion to metal substrates.

Nylon 11 features a very low coefficient of friction and excellent resistance to impact and ultra-violet radiation.



See chart for Actuator Mounting Flange Drilling.

DIMENSIONS SERIES 30 Wafer

Valve Size ins	Valve Size mm	A	B	C	D	E	F	Mounting Flange Drlg. BC	No. Holes	Hole Dia.	G	H	J	K
2	50	3.69	1.62	2.00	2.84	5.50	3.54	2.76	4	.39	.55	.39	1.25	1.32
2½	65	4.19	1.75	2.50	3.34	6.00	3.54	2.76	4	.39	.55	.39	1.25	1.91
3	80	4.88	1.75	3.00	4.03	6.25	3.54	2.76	4	.39	.55	.39	1.25	2.55
4	100	6.06	2.00	4.00	5.16	7.00	3.54	2.76	4	.39	.63	.43	1.25	3.57
5	125	7.06	2.12	5.00	6.16	7.50	3.54	2.76	4	.39	.75	.51	1.25	4.63
6	150	8.12	2.12	5.75	7.02	8.00	3.54	2.76	4	.39	.75	.51	1.25	5.45
8	200	10.50	2.50	7.75	9.47	9.50	5.91	4.92	4	.57	.87	.63	1.25	7.45
10	250	12.75	2.50	9.75	11.47	10.75	5.91	4.92	4	.57	1.18	.87	2.00	9.53
12	300	14.88	3.00	11.75	13.47	12.25	5.91	4.92	4	.57	1.18	.87	2.00	11.47

Valve Size ins	Valve Size mm	A	B	C	D	E	F	Mounting Flange Drlg. BC	No. Holes	Hole Dia.	G	J	KEY SIZE	K
14	350	17.05	3.00	13.25	15.28	13.62	5.91	4.92	4	.57	1.38	2.00	.39x.39	13.04
16	400	19.21	4.00	15.25	17.41	14.75	5.91	4.92	4	.57	1.38	2.00	.39x.39	14.85
18	450	21.12	4.25	17.25	19.47	16.00	8.27	6.50	4	.81	1.97	2.50	.39x.47	16.85
20	500	23.25	5.00	19.25	21.59	17.25	8.27	6.50	4	.81	1.97	2.50	.39x.47	18.73

SERIES 31 Lug

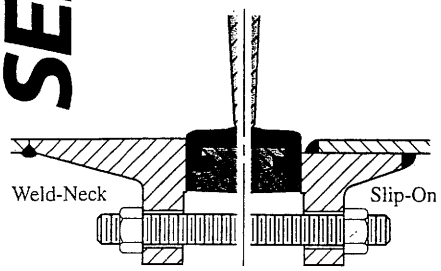
Lug Bolting Data BC	No. Holes	Threads UNC-2B
4.75	4	5/8-11
5.50	4	5/8-11
6.00	4	5/8-11
7.50	8	5/8-11
8.50	8	3/4-10
9.50	8	3/4-10
11.75	8	3/4-10
14.25	12	7/8-9
17.00	12	7/8-9

Lug Bolting Data BC	No. Holes	Threads UNC-2B
18.75	12	1-8
21.25	16	1-8
22.75	16	1 1/8-7
25.00	20	1 1/8-7

SELECTION DATA

FLANGE REQUIREMENTS

Bray valves are designed for installation between ANSI Class 125/150 lb. weld-neck or slip-on flanges, BS 10 Tables D & E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10, either flat faced or raised faced. While weld-neck flanges are recommended, Bray has specifically designed its valve seat to work with slip-on flanges, thus eliminating common failures of other butterfly valve designs. When using raised face flanges be sure to properly align valve and flange. Type C stub-end flanges are not recommended.



PRESSURE RATINGS*

For bi-directional bubble-tight shut off, disc in closed position:

Inches	mm	psig	bar
2-12	50-300	175	12
14-20	350-500	150	10

For Dead-end Service Applications:
With *downstream flanges installed* or with *vulcanized seats,* the dead-end pressure ratings are equal to valve bi-directional ratings as stated above. With no downstream flanges or with seats that are not vulcanized, the dead-end pressure rating for 2"-12" valves is 75 psi (5 bar) for 14"-20" valves, 50 psi (3.5 bar).

*Pressure Ratings are based on standard disc diameters. For low pressure application, Bray offers a standard reduced disc diameter to decrease seating torques and to extend seat life, thus increasing the valve's performance and reducing actuator costs for the customer.

VELOCITY LIMITS

For On/Off Services:
Liquids – 30 ft / sec (9m / s)
Gases – 175 ft / sec (54m / s)

C_V VALUES–VALVE SIZING COEFFICIENT

Valve Size		Disc Position (degrees)								
ins	mm	90°	80°	70°	60°	50°	40°	30°	20°	10°
2	50	144	114	84	61	43	27	16	7	1
2 1/2	65	282	223	163	107	67	43	24	11	1.5
3	80	461	364	267	154	96	61	35	15	2
4	100	841	701	496	274	171	109	62	27	3
5	125	1376	1146	775	428	268	170	98	43	5
6	150	1850	1542	1025	567	354	225	129	56	6
8	200	3316	2842	1862	1081	680	421	241	102	12
10	250	5430	4525	2948	1710	1076	667	382	162	19
12	300	8077	6731	4393	2563	1594	1005	555	235	27
14	350	10538	8874	5939	3384	2149	1320	756	299	34
16	400	13966	11761	7867	4483	2847	1749	1001	397	45
18	450	17214	14496	10065	5736	3643	2237	1281	507	58
20	500	22339	18812	12535	7144	4536	2786	1595	632	72

C_V is defined as the volume of water in U.S.G.P.M. that will flow through a given restriction or valve opening with a pressure drop of one (1) p.s.i. at room temperature. Recommended control angles are between 25°–70° open. Preferred angle for control valve sizing is 60°–65° open.

EXPECTED SEATING/UNSEATING TORQUES (Lb.-Ins.)

Valve Size		Full-Rated Pressure Valves				Reduced Disc Diameter
		ΔP (PSI)				ΔP (PSI)
ins	mm	50	100	150	175	50
2	50	125	130	135	140	125
2 1/2	65	195	205	215	220	195
3	80	260	275	290	297	260
4	100	400	425	450	462	267
5	125	615	670	725	755	410
6	150	783	871	953	1003	537
8	200	1475	1650	1825	1915	983
10	250	2240	2520	2800	2940	1493
12	300	3420	3870	4320	4545	2280
14	350	4950	5700	6450	—	3300
16	400	6400	7700	9000	—	4267
18	450	7850	9850	11850	—	5267
20	500	10300	12900	15500	—	6867

Valve Torque Rating – Bray has classified valve torque ratings according to 3 types: non-corrosive lubricating service, general service, and severe service. Torques listed above are for general services. Consult Bray for torque information corresponding to specific applications.

TO USE TORQUE CHART, NOTE THE FOLLOWING:
1) For Bray valves, Series 20, 21, 30, 31 and 34.
2) Review Technical Bulletin No. 1001, Expected Seating/Unseating Torques, for explanation of the 3 service classes and their related seating/unseating torque values for given pressure differentials of Full-Rated and Reduced Disc Diameter valves.
3) Dynamic Torque values are not considered. See Technical Bulletin No. 1002 for evaluation of Dynamic Torque values vs. Seating/Unseating Torque values.
4) Do not apply a safety factor to above torque values when determining actuator output torque requirement.
5) For 3 way assemblies where one valve is opening and other is closing, multiply torque by 1.5 factor.

SPECIFICATIONS

RECOMMENDED SPECIFICATIONS FOR BRAY SERIES 30/31 SHALL BE:

- Polyester coated, cast iron, wafer or lug bodies.
- With flange locating holes that meet ANSI Class 125/150 (or BS 10 Tables D & E, BS 4504 NP 10/16, DIN ND 10/16, AS 2129 and JIS 10) drillings.
- Through-stem direct drive double "D" design requiring no disc screws or pins to connect stem to disc with no possible leak paths in disc/stem connection.
- Stem mechanically retained in body neck and no part of stem or body exposed to line media.
- Tongue-and-groove seat design with primary hub seal and a molded O-ring suitable for weld-neck and slip-on flanges. Seat totally encapsulates the body with no flange gaskets required.
- Spherically machined, hand polished disc edge and hub for minimum torque and maximum sealing capability.
- Equipped with non-corrosive bushing and self-adjusting stem seal.
- Bi-directional and tested to 110% of full rating.
- Bi-directional pressure ratings:
2"-12" valves: 175 psi, 14"-20" valves: 150 psi
Lug bodies for dead end service
With downstream flanges or vulcanized seats, pressure ratings are equal to bi-directional ratings as stated above.
With no downstream flanges or non-vulcanized seats: 2"-12" valves: 75 psi, 14"-20" valves: 50 psi
- No field adjustment necessary to maintain optimum field performance.
- The valve shall be Bray Series 30 wafer / 31 lug or equal.

WEIGHTS

Valve Size		Series 30	Series 31
ins	mm		
2	50	5.5	7.0
2 1/2	65	7.0	8.0
3	80	7.5	9.0
4	100	11.5	15.0
5	125	14.0	20.0
6	150	17.0	23.0
8	200	34.0	42.0
10	250	49.0	66.0
12	300	67.0	88.0
14	350	95.0	114.0
16	400	135.0	166.0
18	450	200.0	226.0
20	500	260.0	305.0

Weights are in lbs.

MATERIALS SELECTION

2"-20" (50mm-500mm)

BODY:

- Cast Iron ASTM A126 Class B
- Ductile Iron ASTM A536
- Cast Steel ASTM A216 WCB
- Aluminum ASTM B26

SEAT:

- Buna-N – Food Grade
- EPDM – Food Grade
- FKM*
- White Buna-N – Food Grade

STEM:

- Coated Carbon Steel
- 416 Stainless Steel ASTM A582 Type 416
- 304 Stainless Steel ASTM A276 Type 304
- 316 Stainless Steel ASTM A276 Type 316
- Monel

DISC:

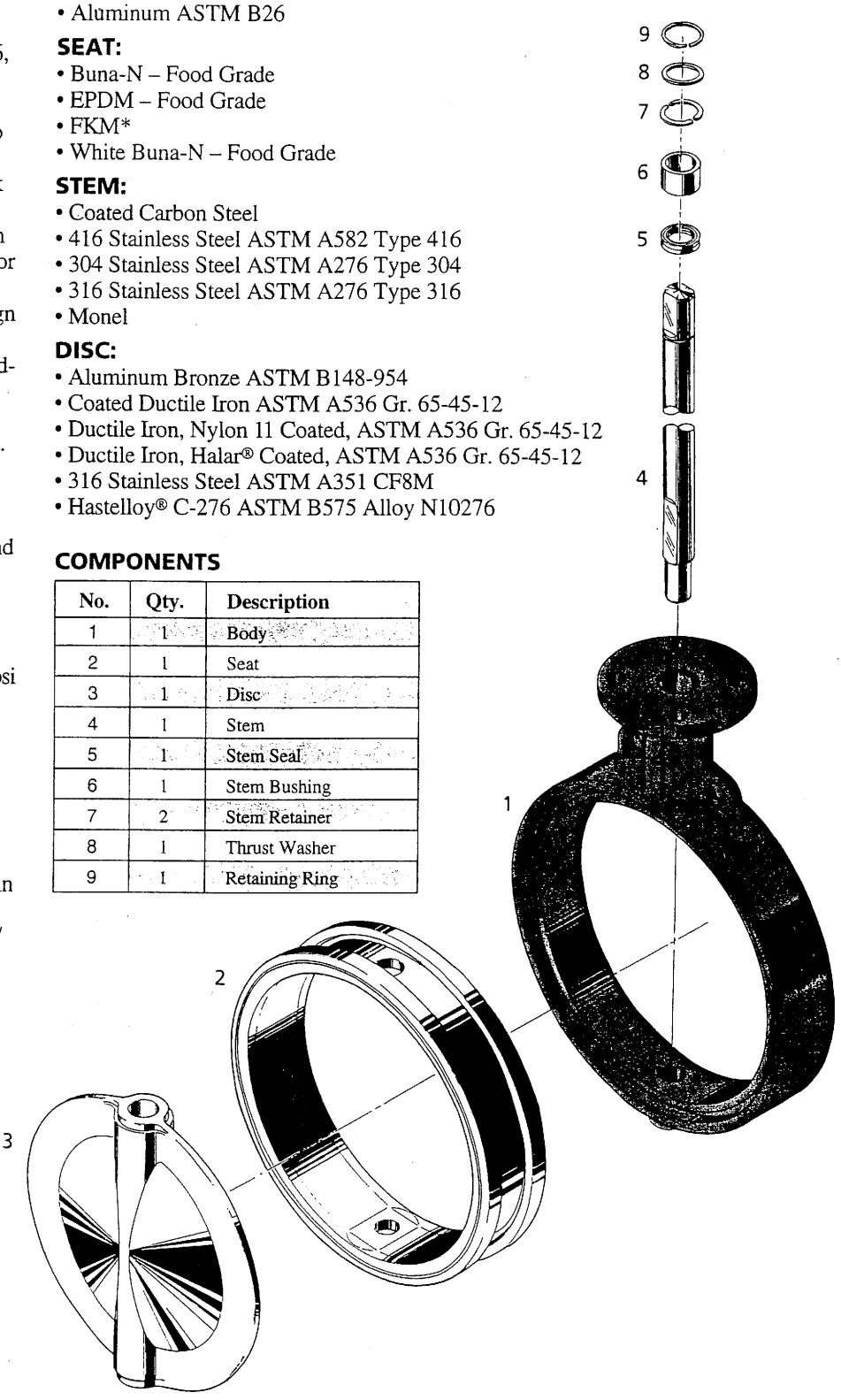
- Aluminum Bronze ASTM B148-954
- Coated Ductile Iron ASTM A536 Gr. 65-45-12
- Ductile Iron, Nylon 11 Coated, ASTM A536 Gr. 65-45-12
- Ductile Iron, Halar® Coated, ASTM A536 Gr. 65-45-12
- 316 Stainless Steel ASTM A351 CF8M
- Hastelloy® C-276 ASTM B575 Alloy N10276

TEMPERATURE RANGE OF SEATS

Type	Maximum	Minimum
EPDM	+250°F(121°C)	-40°F(-40°C)
Buna-N	+212°F(100°C)	0°F(-18°C)
FKM*	+400°F(204°C)	0°F(-18°C)

COMPONENTS

No.	Qty.	Description
1	1	Body
2	1	Seat
3	1	Disc
4	1	Stem
5	1	Stem Seal
6	1	Stem Bushing
7	2	Stem Retainer
8	1	Thrust Washer
9	1	Retaining Ring



*FKM is the ASTM D1418 designation for Fluorinated Hydrocarbon Elastomers (also called Fluoroelastomers).

Hastelloy® is a registered trademark of Haynes International, Inc.
Halar® is a registered trademark of Ausimont U.S.A., Inc.

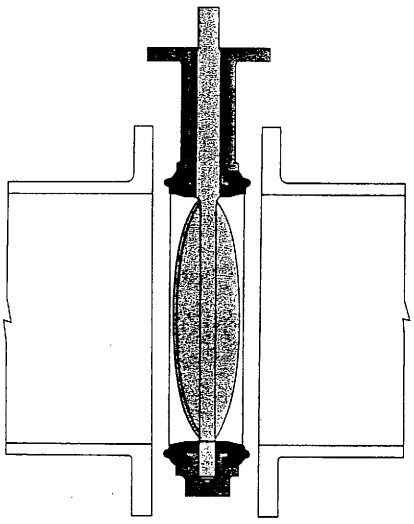
ASSEMBLY

INSTALLATION

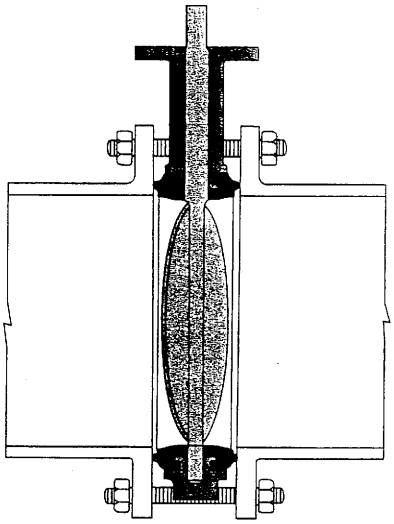
Position the disc in the partially open position, maintaining the disc within the body face-to-face. Place the body between the flanges and install flange bolts. *Do not use flange gaskets.* Before tightening flange bolts, carefully open the disc to the full open position to ensure proper alignment and clearance of the disc O.D. with the adjacent pipe I.D. Leave disc in the full open position and tighten flange bolts per required specification. Once bolts are tightened, carefully rotate disc to closed position to ensure disc O.D. clearance.

MAINTENANCE AND REPAIR

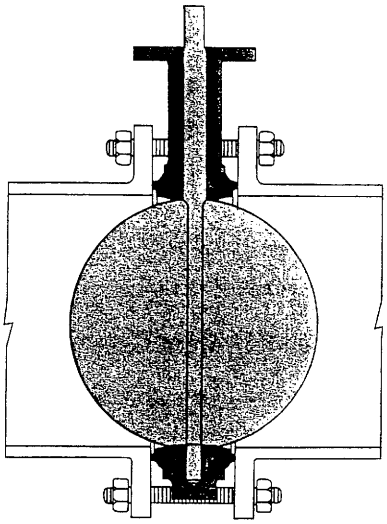
The many Bray features minimize wear and maintenance requirements. No routine lubrication is required. All components – stem, disc, seat, bushing, stem seal, etc., are field replaceable, no adjustment is needed. If components require replacement, remove the valve from the line by placing the disc near the closed position, spread the flanges, support the valve, then remove the flange bolts. No valve maintenance, including removal of manual or power actuators, should be performed until the piping system is completely depressurized.



Disc in the Near Closed Position



Disc in the Partially Open Position



Disc in the Full Open Position

DISASSEMBLY

Remove the handle, gear operator, or actuator from actuator mounting flange. Remove "Spirolox®" retaining ring. Remove stem with its thrust washer and two C-ring stem retainers. Remove bushing and seal. Remove the disc from the seat, protecting disc edge at all times. Push the seat into an oval shape, then remove the seat from the body.

ASSEMBLY

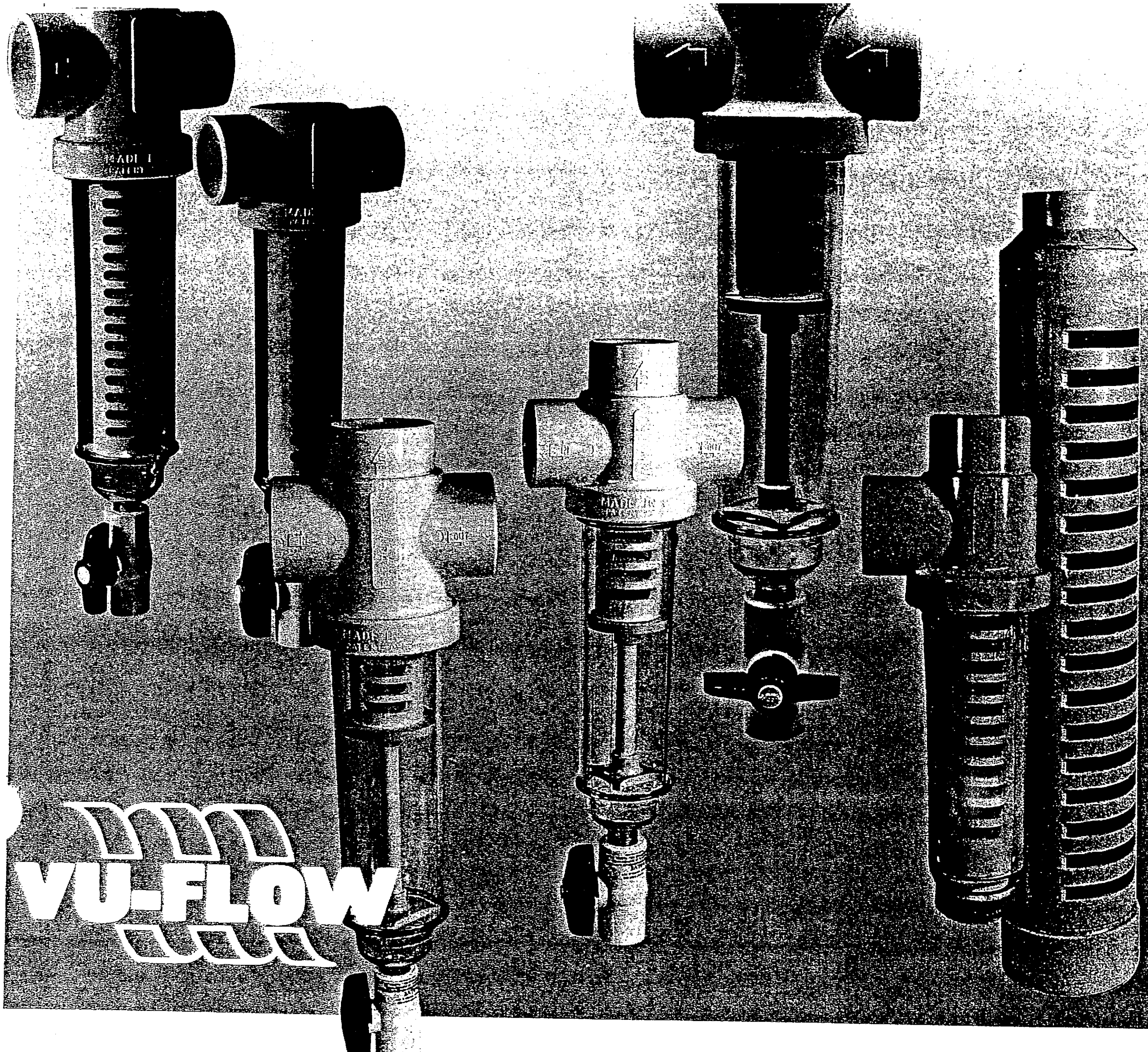
Push the valve seat into an oval and push it into the body with seat stem holes aligned to body stem holes. Push stem into the stem hole of body. For aid in inserting disc, slightly protrude stem beyond the I.D. of the top of the seat. Install a light coating of foodgrade silicone oil (for silicone free applications use soap and water) on the I.D. of seat. Insert the disc into the seat by lining up the disc hole with the stem hole of the seat. Note: the broached double "D" flats in the disc must be toward the bottom of valve body. (Take special care when lining disc up with stem.) With a downward pressure and rotating the stem back and forth, push the stem until the stem touches the bottom of the body stem hole. Make certain that when pushing the stem through disc bottom, the broached flats of stem and disc are aligned. After the stem has engaged the disc, but before the stem is firmly seated in the body, replace the stem seal and bushing. Install the two C-ring stem retainers in the groove in the stem and thrust washer on top of the C-rings. Seat the stem firmly in the body and install the "Spirolox®" retaining ring back into position.

Accredited by the Dutch Council for Certification
ABS Quality Evaluations, Inc. Quality Assurance Certification
ACCREDITED REGISTRAR ANSI-RAB
ISO 9001
Certificate Number: 31938

DISTRIBUTOR

All statements, technical information, and recommendations in this bulletin are for general use only. Consult Bray representatives or factory for the specific requirements and material selection for your intended application. The right to change or modify product design or product without prior notice is reserved.
United States patent number 5,152,501.
Other patents issued and applied for worldwide.

Bray® CONTROLS
A Division of BRAY INTERNATIONAL, Inc.
13333 Westland East Blvd. Houston, Texas 77041
281.894.5454 FAX 281.894.9499 www.bray.com



Screen Filters & Sand Separators

Engineered Protection

PL200 5/99

FEATURES

- Clear cover allows quick view of collected sediment
- Molded PVC filter body allows glue together installation similar to standard PVC pipe fittings
- Most models have ½" MNPT cover drain outlet for quick one step purge cleaning
- Polyester or stainless steel screen mesh is easily cleaned and reusable eliminating expensive element replacement
- Molded from U.V. stabilized weather resistant materials for long service life
- Maximum operating pressure 150 PSI at 73°F (23°C)
- High flow rates 1 to 100 Gallons per Minute
- All models now available for use with reclaimed water. Bodies are purple and all materials are chemical resistant (See literature # PL400).

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

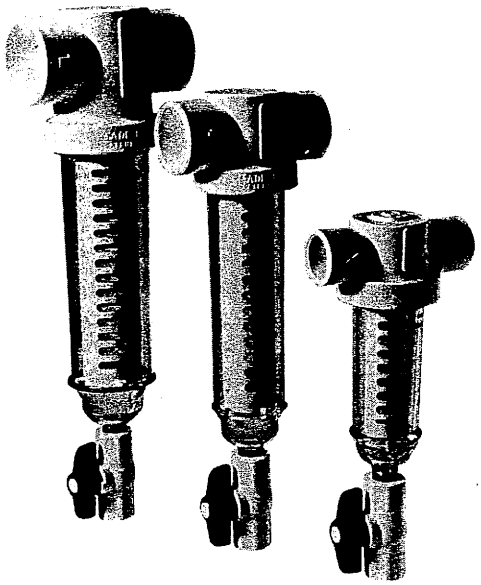
X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/29/03 Department ENG
By MW Mudie

Must be able to be used w/ Filter in UP position

VU-FLOW T Style Screen Filters

- 180 degree in-line "T" style installation
- Increased effective screen area

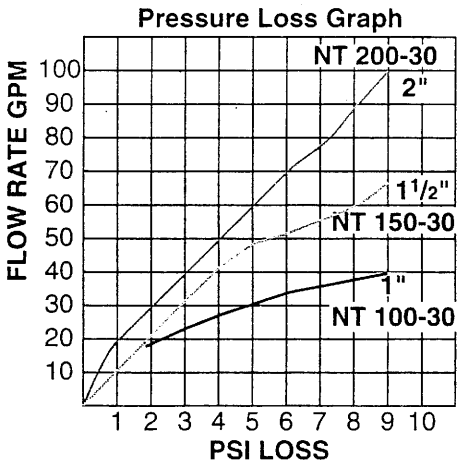


Case Quantity - 10 filters per case.
All filters are individually boxed to prevent loss or damage.

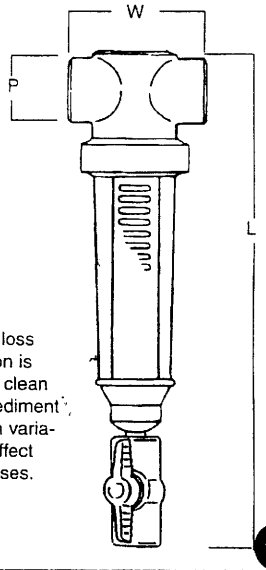
SPECIFICATIONS

Model No.	*Min./Max. Flow	Inlet/ Outlet P	Length L	Width W
NT 100	1-25 GPM	1" SLIP	11 3/8"	5"
NT 150	10-50 GPM	1 1/2" SLIP	15 3/8"	5 1/4"
NT 200	18-100 GPM	2" SLIP	17 7/8"	5 1/2"

* Minimum flow needed for "Spin-out" action.
Reducer Bushings are available for Custom Inlet/Outlet Connection - See Reducer Chart in Price List

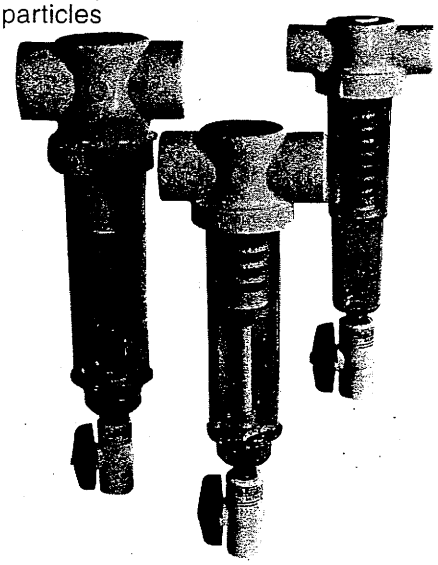


Pressure loss information is based on clean water. Sediment and mesh variation will effect actual losses.



VU-FLOW T Style Sand Separator Filters

- 180 degree in-line "T" style installation
- "Spin-out" action separates heavier than water particles away from screen into the collection chamber
- Screen portion of element removes lighter than water particles

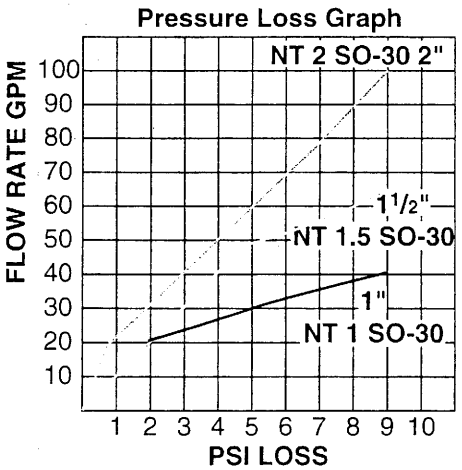


Case Quantity - 10 filters per case
All filters are individually boxed to prevent loss or damage.

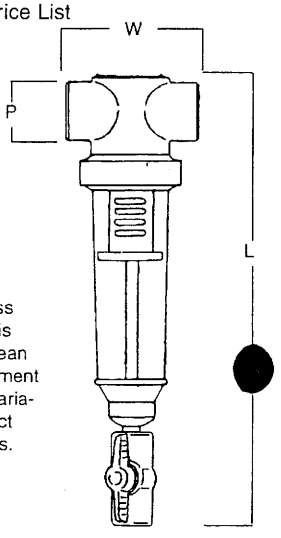
SPECIFICATIONS

Model No.	*Min./Max. Flow	Inlet/ Outlet P	Length L	Width W
NT 1 SO	1-25 GPM	1" SLIP	14 3/8"	5"
NT 1.5 SO	10-50 GPM	1 1/2" SLIP	15 3/8"	5 1/4"
NT 2 SO	18-100 GPM	2" SLIP	17 7/8"	5 1/2"

* Minimum flow needed for "Spin-out" action.
Reducer Bushings are available for Custom Inlet/Outlet Connection - See Reducer Chart in Price List



Pressure loss information is based on clean water. Sediment and mesh variation will effect actual losses.



BERMAD AIR VALVES...protection and performance for all pipelines

Air can dramatically effect the efficiency and integrity of your pipeline system. When filling an empty pipeline air should be uniformly released to eliminate possible damaging pressure surges in your system and to allow valves and other hydraulic components to operate correctly. Air must also be admitted to an emptying pipeline to prevent potentially destructive vacuums from forming. And, lastly, air entrained in the fluid will build up at the high points of the pipeline restricting flow capacity and increasing pumping costs.

Bermad's unique Air and Vacuum Release Valves offer simple, trouble-free, economical solutions to the problems of air in pipelines. Their advanced features include:

- A minimum number of moving parts.
- Corrosion-resistant construction.
- Pressure-balanced floats to prevent distortion.
- Positive sealing under system pressures as low as 2 PSI.
- Exclusive kinetic design prevents float from being blown shut.
- High flow capacity.

USE PLASTIC MODEL

SUBMITTAL REVIEW

This review is only for general conformity with the design concept and is limited to the requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and resubmit
Rejected
Department ENG

Date 7/23/03
By [signature]

1" Automatic Air Release Valve – Model 4405

The 4405 Air Release Valve releases entrapped air pockets which accumulate at the high points of piping systems. These accumulated air pockets reduce system efficiency by decreasing the effective flow area of the pipe.

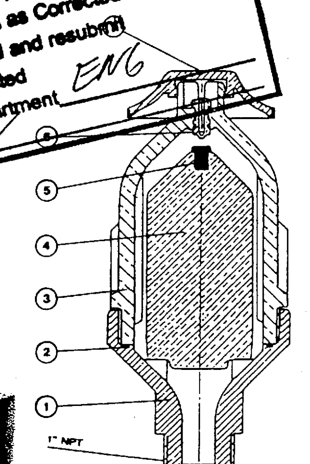
Initially, fluid in the pipeline raises the float and positively seals the specially designed small orifice. During operation air entrained in the fluid rises to the valve high point displacing an equal amount of water and lowering the liquid level. As the air accumulates the float loses buoyancy and drops. This opens the orifice allowing the air to escape. The returning water again raises the float sealing the orifice. This cycle is repeated as often as needed to release the air being accumulated.

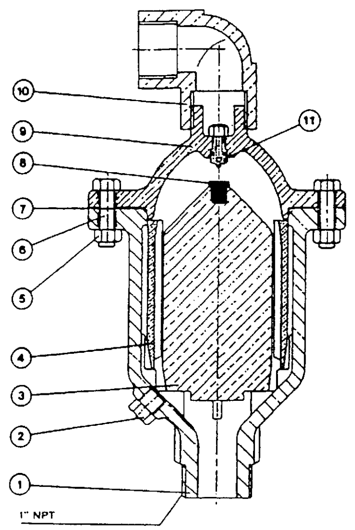
Plastic Model 4405
Automatic Air Release Valve

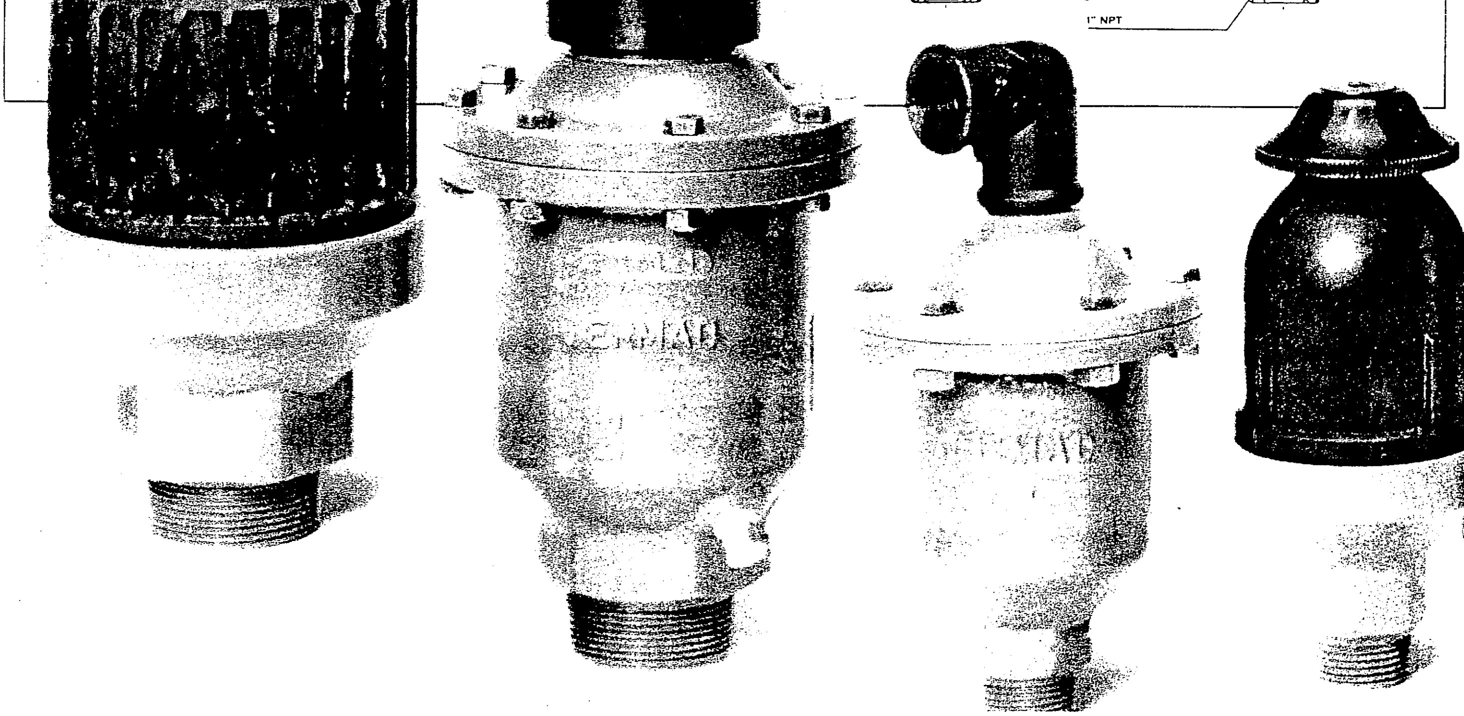
Parts List	Material
1. Base	Plastic
2. Base O-ring seal	Buna N
3. Body	Glass fibre reinforced nylon
4. Automatic Float	Polypropylene
5. Automatic seal plug	Buna N
6. Automatic Orifice	Brass/Stainless steel
7. [illegible] protective [illegible]	Polypropylene

Cast Iron Model 4405M
Automatic Air Release Valve

Parts List	Material
1. Base & Body	Cast iron/ Epoxy coat
2. Drainage plug	Brass
3. Automatic Float	Polypropylene
4. Float housing	Glass fibre reinforced nylon
5. Nut	Stainless steel
6. Bolt	Stainless steel
7. O-ring	Buna N
8. Automatic seal plug	Buna N
9. Cover	Cast iron/ Epoxy coat
10. Elbow	Polypropylene
11. Automatic Orifice	Brass/Stainless steel







NO. 200
REVISED 8/1/89

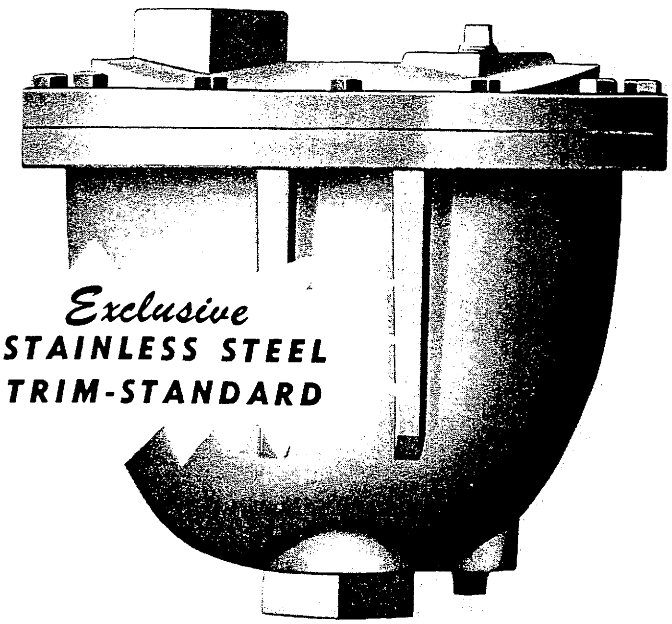
Poly ethylene bodies are required

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

No Exceptions Taken
Furnish as Corrected
Amend and resubmit
X Rejected

6/27/03 ENG

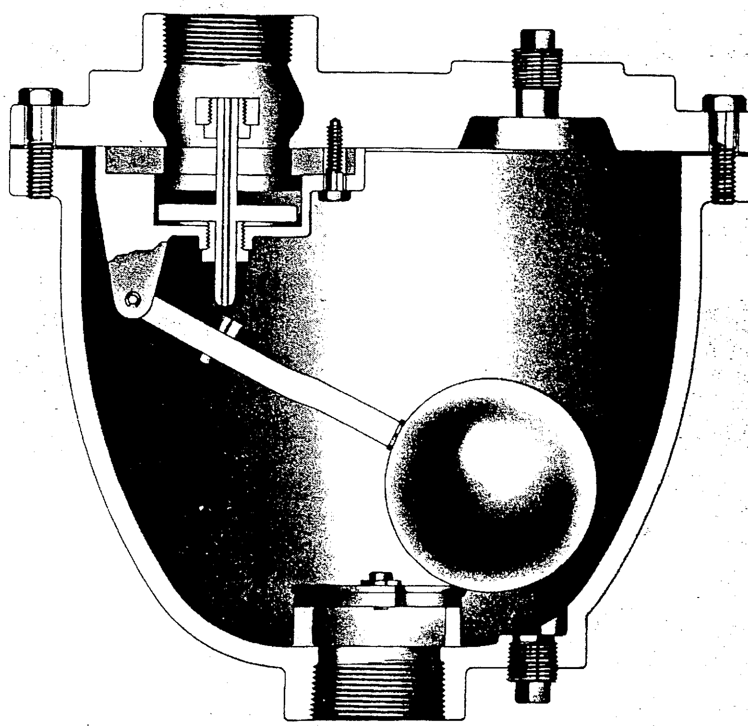
COMBINATION AIR VALVES



Exclusive
STAINLESS STEEL TRIM-STANDARD

FOR:

High Capacity Venting
Pipeline Protection
Flow Efficiency



- ALL S.S. TRIM ELIMINATES DESTRUCTIVE ELECTROLYTIC ACTION WHICH CAN OCCUR WHEN DISSIMILAR METALS SUCH AS S.S. & BRONZE ARE USED TOGETHER

Other Features

- FULL PORTED VALVES— NO RESTRICTIVE AREAS
- STAINLESS STEEL TRIM ASSURES LOW MAINTENANCE
- STAINLESS STEEL FLOATS UNCONDITIONALLY GUARANTEED
- SYNTHETIC SEATING ASSURES DROP TIGHT SEAL AT VERY LOW PRESSURES
- RUGGED CAST IRON BODY AND COVER
- WORKING PRESSURES UP TO 300 P.S.I.
- COMPLETE INTERCHANGEABILITY OF ALL PARTS
- EASILY MAINTAINED WITHOUT SPECIAL TOOLS

VAL-MATIC

VAL-MATIC VALVE AND MANUFACTURING CORP.

905 RIVERSIDE DRIVE • ELMHURST, IL 60126 • 708/941-7600 • TELEX: 28-1091 • FAX: 708/941-8042

COMBINATION AIR VALVES

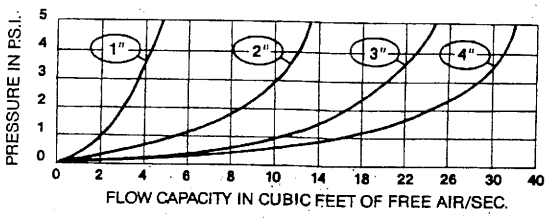
YOU SHOULD USE

Most piping systems require both Air Release Valves and Air Vacuum Valves to maintain pipeline efficiency and provide pipeline protection. Because of this need, the "Combination Air Valve" was developed.

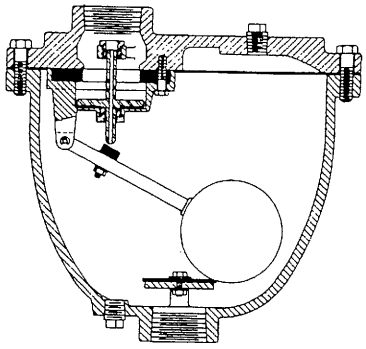
The Val-Matic Combination Air Valve performs both the functions of Air Release and Air/Vacuum Valves. The Air Release valve portion vents air which accumulates at high points in a system during its operation. The Air/Vacuum valve portion will exhaust the larger quantities of air present in a system during the filling and allow air to re-enter during draining.

As with all air valves, these should also be installed at each high point in the system to effectively maintain pipeline efficiency and provide pipeline protection. Refer to Val-Matic "Air Valve Calculator" for sizing information.

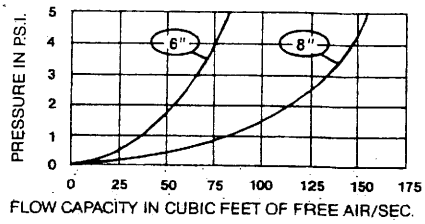
MODEL NO.	AIR/VACUUM INLET X OUTLET N.P.T.	LARGE ORIFICE DIAMETER	AIR RELEASE ORIFICE DIAMETER	MAXIMUM WORKING PRESSURE	HEIGHT	WIDTH	WT. LBS.
201C	1 x 1	1"	5/64"	300 P.S.I.	10½"	11⅜"	40
202C	2 x 2	2"	3/32"	300 P.S.I.	13"	14"	71
203C	3 x 3	3"	3/32"	300 P.S.I.	17"	16"	120
204C	4 x 4	4"	3/32"	300 P.S.I.	19"	18½"	170



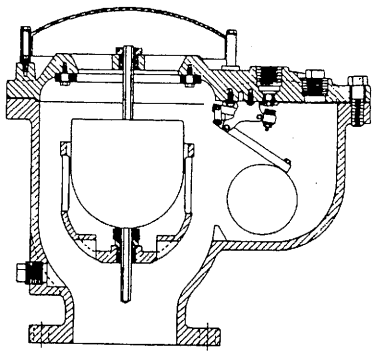
Single Housing Type
1" thru 4" N.P.T. Inlets and Outlets
3"-4" Available W/ANSI Class 125 or 250 Flanged Inlets



MODEL NO.	VALVE SIZE	INLET SIZE	OUTLET SIZE	HEIGHT	WIDTH	ORIFICE SIZE 150 P.S.I.	ORIFICE SIZE 300 P.S.I.	WT. LBS.
206C	6"	6" Flg.	6"	20¼"	21"	3/8"	7/32"	225
208C	8"	8" Flg.	8"	23½"	25"	3/8"	7/32"	320



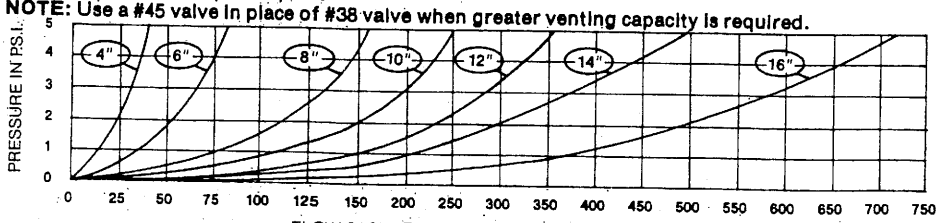
Single Housing Type
6" and 8" ANSI Class
125 or 250 Flanged Inlets

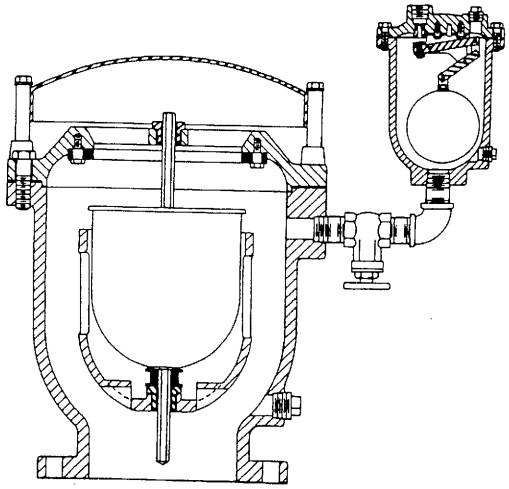


MODEL NO.	*INLET X OUTLET SIZE INCHES	*MAXIMUM WORKING PRESSURE	HEIGHT	WIDTH	WT. LBS.
104/22	4 x 4	150/300 P.S.I.	18"	21"	113
104/38	4 x 4	150/300 P.S.I.	22"	21"	133
106/22	6 x 6	150/300 P.S.I.	21"	24"	160
106/38	6 x 6	150/300 P.S.I.	23"	24"	190
108/38	8 x 8	150/300 P.S.I.	26"	27"	236
110/38	10 x 10	150/300 P.S.I.	28"	30"	398
112/38	12 x 12	150/300 P.S.I.	32"	33"	615
114/38	14 x 14	150/300 P.S.I.	34"	36"	705
116/38	16 x 16	150/300 P.S.I.	34"	39"	903

*Flanged Inlet ANSI Class 125 for 150 P.S.I. & ANSI Class 250 for 300 P.S.I. W.P. Higher working pressures available upon request.

NOTE: Use a #45 valve in place of #38 valve when greater venting capacity is required.



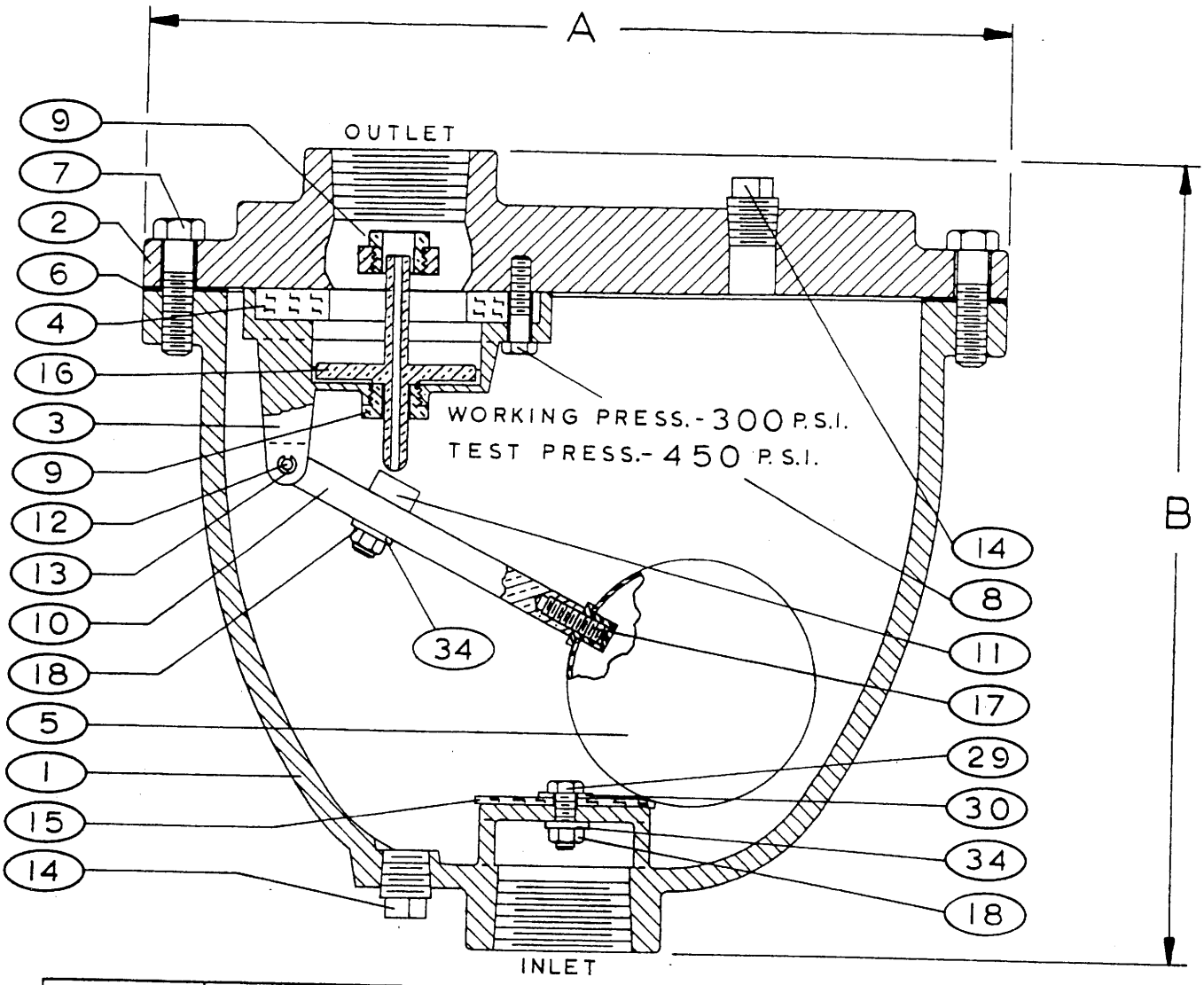


Custom Built Type
4" thru 16" ANSI Class
125 or 250 Flanged Inlets

N.P.T. and Flanged Outlets Available Upon Request

VAL-MATIC
VAL-MATIC VALVE AND MANUFACTURING CORP.
905 RIVERSIDE DRIVE • ELMHURST, IL 60126
708/941-7600 • TELEX 28-1001 • FAX 708/941-8042

DISTRIBUTED BY



VALVE SIZE	*VALVE NO.	A	B	INLET SIZE	OUTLET SIZE	ORIFICE SIZE
1"	201C.2	11 3/8"	10 1/2"	1" N.P.T.	1" N.P.T.	5/64"
2"	202C.2	14"	13"	2" N.P.T.	2" N.P.T.	3/32"

1 BODY
2 COVER
3 BAFFLE
4 SEAT
5 FLOAT
6 GASKET
7 COVER BOLTS
8 BAFFLE SCREWS
9 BUSHING
10 FLOAT ARM
11 ORIFICE BUTTON
12 PIVOT PIN
13 RETAINING RING
14 PIPE PLUG
15 CUSHION
16 PLUG
17 FLOAT RETAINER
18 LOCK NUT
29 CUSHION RETAINER
30 WASHER
34 LOCK WASHER

*ABOVE MODEL NUMBERS REFLECT STAINLESS STEEL TRIM, IF BRONZE TRIM IS REQUIRED, OMIT THE .2 FROM THE MODEL NUMBER.

REV. 8-15-90

COMBINATION AIR RELEASE, AIR & VACUUM VALVE

DATE 2-2-69

VAL-MATIC VALVE AND MANUFACTURING CORP.

DRWG. NO. VM-201C

COMBINATION AIR VALVES
MATERIALS OF CONSTRUCTION
SERIES 200C, STAINLESS STEEL TRIM
SIZES 1" THROUGH 4"

PART NO.	PART NAME	MATERIAL
1	BODY	CAST IRON A.S.T.M. A126, CLASS B
2	COVER	CAST IRON A.S.T.M. A126, CLASS B
3	BAFFLE	CAST IRON A.S.T.M. A126, CLASS B
4	SEAT	BUNA - N
5	FLOAT	STAINLESS STEEL A.S.T.M. A240
6	GASKET	LEXIDE NK-511 (NON-ASBESTOS)
7	COVER BOLT	ALLOY STEEL A.S.T.M. A449, GRADE 5
8	RETAINING SCREWS	STAINLESS STEEL A.S.T.M. A276
9	GUIDE BUSHING	STAINLESS STEEL S.A.E. 30303
10	FLOAT ARM	STAINLESS STEEL S.A.E. 30303
11	ORIFICE BUTTON	STAINLESS STEEL & BUNA - N
12	PIVOT PIN	STAINLESS STEEL S.A.E. 30303
13	RETAINING RING	STAINLESS STEEL PH 15-7 MO
14	PIPE PLUG	MALLEABLE IRON
15	CUSHION	BUNA - N
16	PLUG	STAINLESS STEEL A.S.T.M. A276
17	FLOAT RETAINER	STAINLESS STEEL A.S.T.M. A276
18	LOCK NUT	STAINLESS STEEL A.S.T.M. A276
29	CUSHION RETAINER	STAINLESS STEEL A.S.T.M. A276
30	WASHER	STAINLESS STEEL A.S.T.M. A276

NOTE: ALL SPECIFICATIONS AS LAST REVISED.

REV. 8-15-90

MATERIALS OF CONSTRUCTION (STAINLESS STEEL TRIM)

DATE 11-15-77

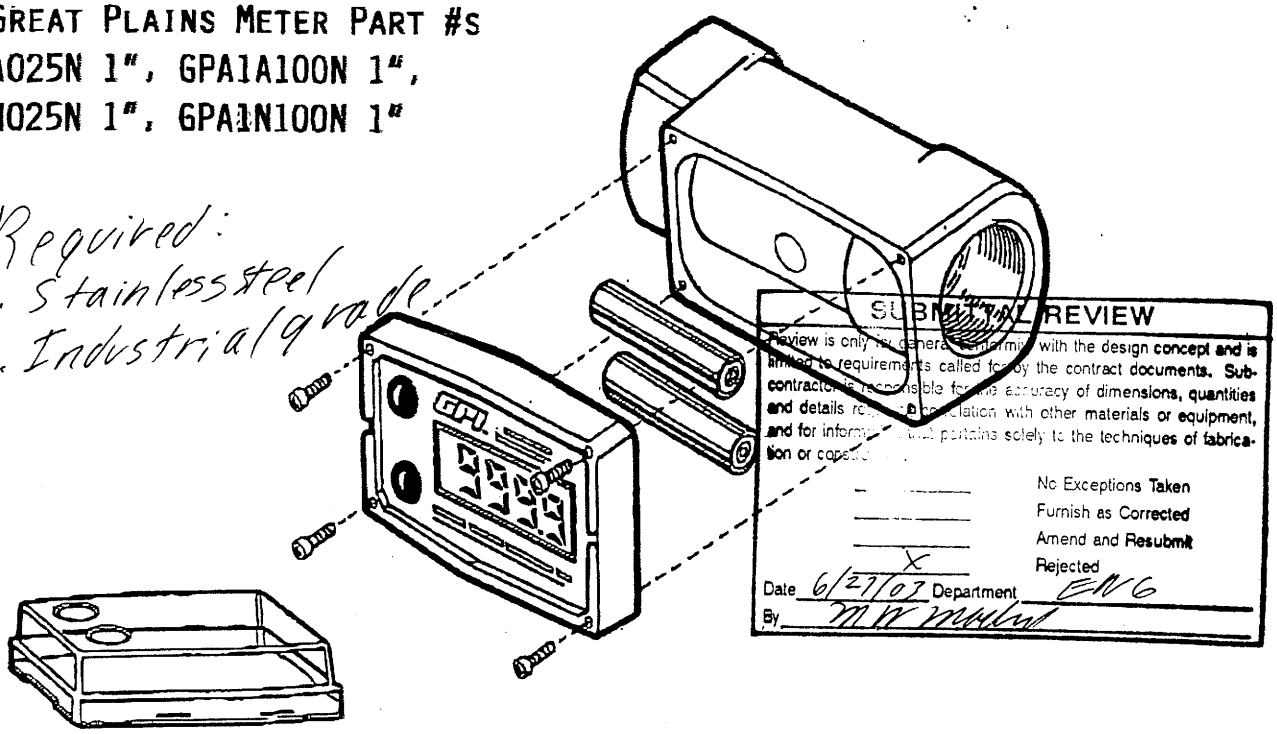
VAL-MATIC VALVE AND MANUFACTURING CORP.

DRWG. NO. VM-201C-M

GPI® Commercial Grade Metering Products

FOR GREAT PLAINS METER PART #S
GPA1A025N 1", GPA1A100N 1",
GPA1N025N 1", GPA1N100N 1"

Required:
1. Stainless steel
2. Industrial grade



HOUSING SPECIFICATIONS

	Aluminum			Nylon	
	Low Flow	**One Inch**	**Two Inch**	**Low Flow**	**One Inch**
U.S. Measurements					
Units*	Gallons	Gallons	Gallons	Gallons	Gallons
Flow Range in GPM	0.3 to 3	3 to 50	30 to 300	0.3 to 3	3 to 50
Threads*	NPT	NPT	NPT	NPT	NPT
Pressure Rating	300 PSIG	300 PSIG	300 PSIG	150 PSIG	150 PSIG
Pressure Drop at Max. Flow Rate	2 PSIG at 3 GPM	5 PSIG at 50 GPM	7 PSIG at 300 GPM	2 PSIG at 3 GPM	5 PSIG at 50 GPM
Dimensions					
Length	4 inches	4 inches	6 inches	4 inches	4 inches
Height	2.5 inches	2.5 inches	4.25 inches	2.5 inches	2.5 inches
Width	2 inches	2 inches	3 inches	2 inches	2 inches
U.S. and Metric					
Female Inlet and Outlet	1 inch	1 inch	2 inch	1 inch	1 inch
Internal Diameter	1/4 inch	1 inch	2 inch	1/4 inch	1 inch
Design Type	Paddlewheel	Turbine	Turbine	Paddlewheel	Turbine
Accuracy					
Factory Calibration**	N/A†	±1.5%	±1.5%	N/A†	±1.5%
Field Calibration**	±1.5%	±1%	±1%	±1.5%	±1%
Readout Totals					
Minimum	.01	.01	.01	.01	.01
Maximum	999,999	999,999	999,999	999,999	999,999

* Models are also available in litre measurement with NPT threads

Commercial Grade Metering Products

COMPUTER SPECIFICATIONS

Computer Models*	Readout Label	03	04	05	06	07	08
Field Replaceable Batteries		Yes	Yes	Yes	Yes	Yes	Yes
On/Off							
Automatic On		Yes	Yes	Yes	Yes	Yes	No
Manual On		Yes	Yes	Yes	Yes	Yes	Yes
Automatic Off		Yes	Yes	Yes	Yes	Yes	Yes
Totalizers							
Cumulative Total	TOTAL 1 LOCKED	Yes	Yes	Yes	Yes	Yes	No
First Batch Total	TOTAL 2	Yes	Yes	Yes	Yes	Yes	No
Second Batch Total	TOTAL 3	No	No	Yes	No	Yes	No
Calibration							
Factory Calibration Curve	CAL A PRESET	Yes	Yes	Yes	Yes	Yes	Yes
First Field Calibration Curve	CAL B	Yes	Yes	Yes	No	Yes	Yes
Second Field Calibration Curve	CAL C	No	No	Yes	No	Yes	No
Rate of Flow	FLOWRATE	No	Yes	No	No	Yes	Yes
Bypass Feature	BYPASS	No	No	Yes	No	Yes	No

* Computer electronics operate from +14° to +140°F (–10° to +60°C).

COMPUTER FEATURES

Power source is two lithium batteries for approximately 4,000 hours of actual use.

- **Automatic or manual on and automatic off** are contained in most models.
- The **Batch Total** is the total liquid metered since the last manual clearing of this total.
- The **Cumulative Total** is the total of all liquid metered since battery connection.
- The **Field Calibration Curve**, with accuracy within ± 1%, is set and changed by the user.
- The **Factory Calibration Curve**, with accuracy within ± 1.5%, is preset by the manufacturer and covers a wide variety of fluids.
- **Rate of Flow** allows the display of rate of flow, as opposed to volume of flow.
- **Bypass** conserves power in continuous flow situations. After a few minutes in bypass, the meter's readout goes off.

REMOTE KIT SPECIFICATIONS

	Low Flow	One Inch	Two Inch
U.S. Measurement			
Fluid Temperature Range*	–40° to +250°F	–40° to +250°F	–40° to +250°F
Transmission Distance	Up to 300 feet	Up to 300 feet	Up to 300 feet
Metric Measurement			
Fluid Temperature Range*	–40° to +121°C	–40° to +121°C	–40° to +121°C
Transmission Distance	Up to 30.5 meters	Up to 30.5 meters	Up to 30.5 meters
U.S. and Metric			
Signal Type	Sine Wave	Sine Wave	Sine Wave
Peak to Peak Voltage	33 mV to 900 mV	48 mV to 825 mV	50 mV to 500 mV
Frequency	11 Hz to 111 Hz	30 Hz to 608 Hz	40 Hz to 360 Hz

Call GPI Sales for further information on Factory Mutual Approved Remote Kits.

GREAT PLAINS INDUSTRIES, INC.

NEMA

Operation and Maintenance Manual

Magnetoflow Primo Advanced

28. Mai. 03

Serial number: 0305-007 /18282346

Part number: 9010101

Part code: MID 2-80/150-A/St-HG-ML/HC-St PA0

Detector type: Type 2

Size DN: 80 **Pressure rating:** 150 ASA

Amplifier: Primo Advanced US

Mounting: Remote mounted Submersible **Cable length:** 15 Ft.

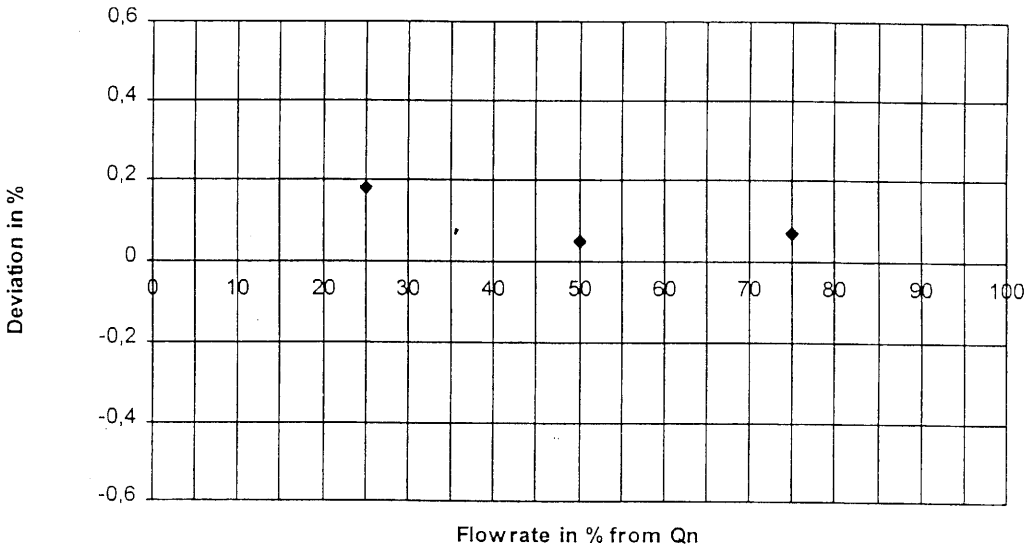
Detector constant: 89,80

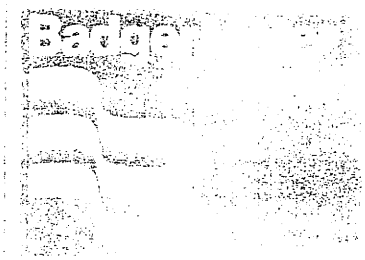
Amplifier constant: 2,50

Full scale Qn: 200 GPM

	Flow rate in % f. Qn	Deviation in %
Measure point 1	25	0,18
Measure point 2	50	0,05
Measure point 3	75	0,07

Calibration chart





Magnetoflow Primo Advanced

28. Mai. 03

Serial number:	0305-007 /18282346
Part number:	9010101
Part code:	MID 2-80/150-A/St-HG-ML/HC-St PA0
Detector type:	Type 2
Nominal size:	80 **Pressure rating:** 150 ASA
Connection:	Flanges acc. ANSI **Material:** C-Steel
Liner:	Hard Rubber **Max. temperature:** 80 °C
Electrode:	Measuring and empty pipe electrodes
Electrode material:	Hastelloy C
Detector housing:	C-Steel painted **Protection class:** IP 65
Transformer:	Primo Advanced US
Mounting:	Remote mounted submersible **Cable length:** 15 Ft.
Transformer housing:	Cast aluminium **Protection class:** IP 65
Power supply:	85 - 265 VAC
Flow range:	2,4 bis 800 GPM
Detector constant:	89,80
Amplifier constant:	2,50
Flow direction:	Uni-directional
Min/Max Alarm:	Min = 0 % Max = 100 %
Low flow cut off:	0,2 %
Empty pipe detection active:	☑
Pre selection counter:	☑
Analog output:	+/- 4...20 mA **Full scale (20 mA):** 200 GPM
Pulse rate:	1 pulse per Galon
Pulse width:	1:1 ms
Pulse output:	24 V DC / Optocoupler
Interface:	No
Software version:	V3.1Ues
Coil adjustment:	3x10 Ohm

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER PPFA Plastic Pipe and Fittings Association

SUBMITTAL REVIEW
Review is only for general conformance with the design ... limited to requirements called for in the contract documents. Sub-contractor is responsible for the accuracy of dimensions, quantities and details requiring confirmation ... the techniques of fabrication and for information ... or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 6/21/83 Department EWG
By D.N.

SPECIFICATION SHEET
Effective June 1, 1992

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 22-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
	1¼"	1.660	1.532	.064	160	22.00	3920'	28
EAGLE	G 1½"	1.900	1.754	.073	160	28.90	3020'	28
PVC	G 2"	2.375	2.193	.091	160	43.00	2100'	28
160 PSI	G 2½"	2.875	2.655	.110	160	63.30	1460'	28
Pressure Pipe	G 3"	3.500	3.230	.135	160	92.30	920'	28
SDR 26	G 4"	4.500	4.154	.173	160	155.90	580'	28
Available in BOE	5"	5.563	5.135	.214	160	238.83	460'	24
	G 6"	6.625	6.115	.255	160	338.15	400'	20
	G 8"	8.625	7.962	.332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

SIZES MARKED WITH "G" AVAILABLE WITH MOLDED IN PLACE GASKET
WHEN ORDERING GASKETED PIPE, PLEASE SPECIFY "GASKETED".

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
	1/2"**	.840	.716	.062	315	10.60	12000'	28
	3/4"	1.050	.930	.060	200	13.00	8100'	28
	1"	1.315	1.189	.063	200	17.00	6300'	28
EAGLE	1¼"	1.660	1.502	.079	200	26.80	3920'	28
PVC	G 1½"	1.900	1.720	.090	200	34.50	3020'	28
200 PSI	G 2"	2.375	2.149	.113	200	52.00	2100'	28
Pressure Pipe	G 2½"	2.875	2.601	.137	200	76.80	1460'	28
SDR 21	G 3"	3.500	3.166	.167	200	112.70	920'	28
Available in BOE	G 4"	4.500	4.072	.214	200	190.45	580'	28
	5"	5.563	5.033	.265	200	291.41	460'	24
**½" SDR 13.5	G 6"	6.625	5.993	.316	200	413.69	400'	20
	G 8"	8.625	7.804	.411	200	705.15	280'	16

Eagle PVC meets all the requirements of ASTM D2241 and D1784 and is listed by NSF International for potable water.

Eagle PVC is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts.

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

Form No. EP-5

Eagle Plastics, Inc.
146 N. Maple, P.O. Box 229
Hastings, NE 68902-0229
402-461-3040
FAX 402-461-3409

MEMBER
PPFA
Plastic Pipe and Fittings Association

SPECIFICATION SHEET
Effective June 1, 1992

... L REVIEW
Review ... limited to ... the design concept and is ... contract documents. Sub-contractor ... dimensions, quantities and details ... or equipment, and for ... techniques of fabrication or co...
X No Exceptions Taken
... Corrected
Amend and Resubmit
Rejected
Date 6/27/03 Department ENG
By D.N.

EAGLE
PVC 1120 PLASTIC PIPE
TYPE 1 SEMI-RIGID

Conforms to U.S. Department of Commerce Standard PS 21-70

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 40 Pressure Pipe Available in BOE	1/2"	.840	.612	.109	600	16.40	12000'	28
	3/4"	1.050	.824	.113	480	21.80	8100'	28
	1"	1.315	1.049	.133	450	32.10	6300'	28
	1¼"	1.660	1.380	.140	370	43.40	3920'	28
	1½"	1.900	1.610	.145	330	51.80	3020'	28
	2"	2.375	2.067	.154	280	69.50	2100'	28
	2½"	2.875	2.469	.203	300	109.60	1460'	28
	3"	3.500	3.068	.216	260	143.50	920'	28
	4"	4.500	4.026	.237	220	209.41	580'	28
	5"	5.563	5.047	.258	190	284.54	460'	24
	6"	6.625	6.065	.280	180	369.00	400'	20
	8"	8.625	7.962	332	160	576.39	280'	16

Sizes below 4" available only in standard 20' lengths.
Sizes 4" & above available only in 20' laying lengths.

	Nominal Size	O.D.	I.D.	Wall	Working Pressure @ 73°F PSI	Weight Per 100'	Pallet Quantities	Pallets Per Truckload
EAGLE PVC Schedule 80 Pressure Pipe Available in Plain end only	1/2"	.840	.546	.147	850	20.50	12000'	28
	3/4"	1.050	.742	.154	690	27.80	8100'	28
	1"	1.315	.957	.179	630	40.90	6300'	28
	1¼"	1.660	1.278	.191	520	56.70	3920'	28
	1½"	1.900	1.500	.200	470	68.60	3020'	28
	2"	2.375	1.939	.218	400	94.90	2100'	28
	2½"	2.875	2.323	.276	420	144.90	1460'	28
	3"	3.500	2.900	.300	370	193.80	920'	28
	4"	4.500	3.826	.337	320	283.30	580'	28
	5"	5.563	4.813	.375	290	396.45	460'	24
	6"	6.625	5.761	.432	280	544.64	400'	20
	8"	8.625	7.625	.500	250	827.00	280'	16

Available in 20' lengths only. Available in white or gray. 8" in gray only.

Eagle PVC Schedule 40 and Schedule 80 meets all the requirements of ASTM D1785 and D1784 and is listed by NSF International for potable water.

Eagle PVC Schedule 40 and Schedule 80 is covered by our limited warranty, which may be found in the "Warranty" section of our catalog.

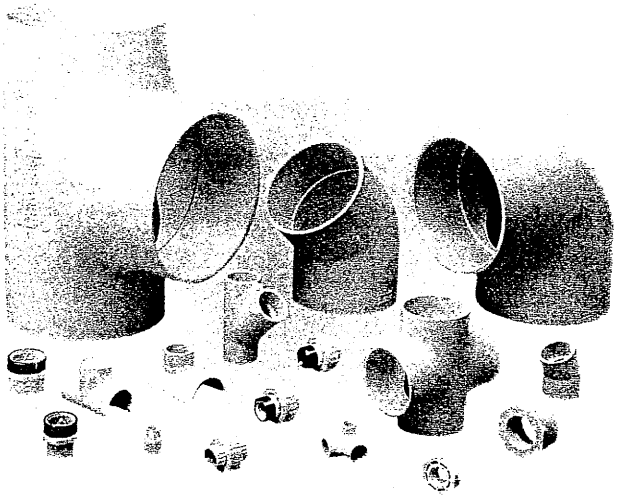
NOTE: PVC pipe in 1¼" and above must be ordered in pallet quantities for maximum discounts. PVC Schedule 40 **Not** recommended for threading. PVC Schedule 80 is suitable for threading, however, pressure ratings listed above are reduced by 50% when pipe is threaded.

NOTE: INSTALLATION OF PVC SCHEDULE 80 PIPE REQUIRES SPECIAL JOINING PROCEDURES AND SOLVENT CEMENTS. (See Paragraph #9 on reverse side.)

SEE PVC MASTER LIST PRICE SHEET FOR CURRENT PRICES

PVC SCHEDULE 40 FITTINGS

40-2-0297



PERFORMANCE ENGINEERED & TESTED

SPEARS Schedule 40 PVC fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material reinforcement is uniformly placed in stress concentration areas for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure the very best PVC fittings available.

- **Full 1/4" Through 12" Availability**
  Spears comprehensive line of PVC fittings offers a variety of injection molded configurations in Schedule 40 sizes 1/4" through 12".
- **Exceptional Chemical & Corrosion Resistance**
  Unlike metal, PVC fittings never rust, scale, or pit, and will provide many years of maintenance-free service and extended system life.
- **High Temperature Ratings**
  GEON® PVC thermoplastic can handle fluids at service temperatures up to 140° F (60°C), allowing a wide range of process applications, including corrosive fluids.
- **Higher Flow Capacity**
  Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.
- **Lower Installation Costs**
  Substantially lower material costs than steel alloys or lined steel, combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.
- **GEON® PVC Valves**
  SPEARS GEON® PVC Valve products are available for total system compatibility and uniformity; see **SPEARS'** ***THERMOPLASTIC VALVES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS*** (V-4).
- **Additional Fabricated Configurations through 24"**
  Extra large, hard-to-find, and custom configurations are fabricated from NSF Listed Schedule 40 pipe. Fittings are engineered and tested to provide full pressure handling capabilities according to Spears specifications.
- **Advanced Design Specialty Fittings**
  Spears wide range of innovative, improved products include numerous metal-to-plastic transition fittings and unions with brass thread inserts and Spears' patented stainless steel reinforced (SR) plastic threads.

MADE IN THE U.S.A. WITH PRIDE

LPCB LOSS PREVENTION CERTIFICATION BOARD — NATIONAL ACCREDITATION OF CERTIFICATION BODIES

Quality Systems Certificate No. 293
Corporate Facilities, Sylmar, CA
Assessed to ISO 9001

Sample Engineering Specifications

All PVC Schedule 40 injection molded fittings shall be produced by Spears Manufacturing Company from PVC, cell classification 12454-B, conforming to ASTM Standard D 1784. All PVC Schedule 40 injection molded fittings shall be listed for potable water service by the National Sanitation Foundation (NSF) and manufactured in strict compliance to ASTM D 2466.

GEON® PVC Thermoplastic Material Temperature Pressure De-rating

System Operating Temperature °F (°C)	73 (23)	80 (27)	90 (32)	100 (38)	110 (43)	120 (49)	130 (54)	140 (60)
PVC	100%	90%	75%	62%	50%	40%	30%	22%

NOTE: Threaded PVC products should not be used at temperatures above 110°F (43°C). Valves, Unions and Specialty Products have different elevated temperature ratings than pipe and fittings.

GEON® PVC Basic Physical Properties

Properties	ASTM Test Method	PVC
Mechanical Properties, 73°F		
Specific Gravity, g/cm^3	D 792	1.41
Tensile Strength, psi	D 638	7,000
Modulus of Elasticity, psi	D 638	440,000
Compressive Strength, psi	D 695	9,000
Flexural Strength, psi	D 790	13,200
Izod Impact, notched, ft-lb/in	D 256	.65
Thermal Properties		
Heat Deflection Temperature,°F at 66 psi	D 648	165
Thermal Conductivity, BTU/hr/sq ft/°F/in	C 177	1.2
Coefficient of Linear Expansion, in/in/°F	D 696	3.0 x 10^{-5}
Flammability		
Limiting Oxygen Index, %	D 2863	43
UL 94 Rating		94V-0
Other Properties		
Water Absorption, % 24 hr.	D 570	.05
Industry Standard Color		White/ Dark Gray
ASTM Cell Classification	D 1784	12454-B
NSF Potable Water Approved		Yes

GEON® PVC Chemical Resistance

PVC is generally inert to most mineral acids, bases, salts and paraffinic hydrocarbon solutions. For more information on PVC chemical resistance refer to the Chemical Resistance of Rigid GEON® Vinyls Based on Immersion Test, Technical Service Report 15.

NOT FOR USE WITH COMPRESSED AIR OR GASES

Spears Manufacturing Company **DOES NOT RECOMMEND** the use of thermoplastic piping products for systems to transport or store compressed air or gases, or the testing of thermoplastic piping systems with compressed air or gases in above and below ground locations. The use of our product in compressed air or gas systems automatically voids any warranty for such products, and its use against our recommendation is entirely the responsibility and liability of the installer.

WARNING: *DO NOT USE COMPRESSED AIR OR GAS TO TEST ANY PVC OR CPVC THERMOPLASTIC PIPING PRODUCT OR SYSTEM, AND DO NOT USE DEVICES PROPELLED BY COMPRESSED AIR OR GAS TO CLEAR SYSTEMS. THESE PRACTICES MAY RESULT IN EXPLOSIVE FRAGMENTATION OF SYSTEM PIPING COMPONENTS CAUSING SERIOUS OR FATAL BODILY INJURY.*

SPEARS® MANUFACTURING COMPANY

CORPORATE OFFICES

15853 Olden Street, Sylmar, California 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611 • http://www.spearsmfg.com

MADE IN THE U.S.A. WITH PRIDE

PACIFIC SOUTHWEST
15860 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203, Sylmar, CA 91392
(818) 364-1611
(800) 862-1499
FAX: (818) 367-3014

NORTHWEST
3902 "B" Street N.W.
Auburn (Seattle), WA
98002
(253) 939-4433
(800) 347-7327
FAX: (253) 939-7557

ROCKY MOUNTAIN
4800 Nome Street
Denver, CO
80239
(303) 371-9430
(800) 777-4154
FAX: (303) 375-9546

SOUTH CENTRAL
1838 Forms Drive
Carrollton (Dallas), TX
75006
(972) 245-0387
(800) 441-1437
FAX: (972) 245-4205

UTAH
1415 South 700 West #3
Salt Lake City, UT
84104
(801) 972-0659
FAX: (801) 972-0688

NORTHEAST
543 Industrial Drive
Lewisberry (Harrisburg), PA
17339-9532
(717) 938-8844
(800) 233-0275
FAX: (717) 938-6547

SOUTHEAST
2751 Miller Road
Decatur (Atlanta), GA
30035
(770) 981-7122
(800) 662-6326
FAX: (770) 981-6106

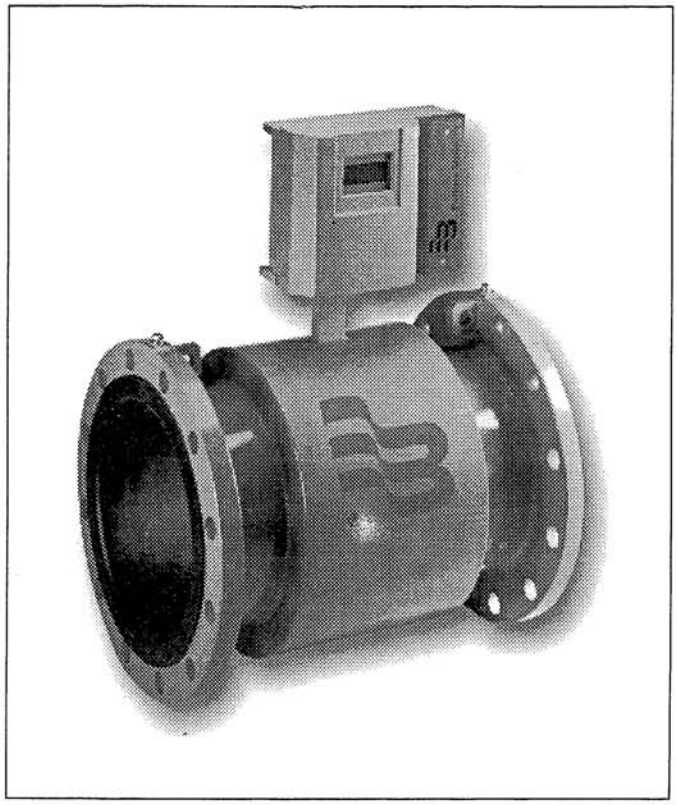
FLORIDA
3445 Bartlett Boulevard
Orlando, FL
32811
(407) 843-1960
(800) 327-6390
FAX: (407) 425-3563

MIDWEST
854 Fairway Drive
Bensenville (Chicago), IL
60106
(630) 773-0075
(800) 662-6330
FAX: (630) 773-0435

INTERNATIONAL SALES
15853 Olden Street
Sylmar (Los Angeles), CA 91342
P.O. Box 9203
Sylmar, CA 91392
(818) 364-1611
FAX: (818) 898-3774

 40-2-0297

Magnetoflow® Mag Meter	Flanged Meter with Model Primo® 3.1	Installation & Operation Manual



IMPORTANT !!!! This manual contains important warnings and information. READ AND KEEP FOR REFERENCE.

SCOPE OF THIS MANUAL

This manual contains information concerning the installation, operation and maintenance of Badger's Magnetoflow® electromagnetic flow meter models with Primo® Amplifier.

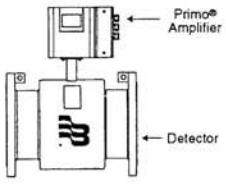
To ensure proper meter performance, the instructions given in this manual should be thoroughly understood. Keep a copy of this manual in a readily accessible location for future reference.

TABLE OF CONTENTS

SYSTEM DESCRIPTION

Magnetoflow® electromagnetic flow meters are intended for fluid metering in most industries including water, wastewater, food and beverage, pharmaceutical and chemical.

The basic components of an electromagnetic flow meter are two: 1) The Detector; which includes the flow tube, isolating liner and measuring electrodes, and 2) the Amplifier, which is the electronic device responsible for the signal processing, flow calculation, display and output signals.



The materials of construction of the wetted parts (liner and electrodes) should be appropriate for the specifications on the intended type of service. Review of the compatibilities consistent with the specifications is recommended.

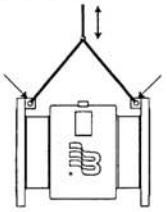
All Badger's Magnetoflow mag flow meters are factory tested and calibrated. A calibration certificate is included in the shipment of each meter.

UNPACKING AND INSPECTION

Magnetoflow mag flowmeters are shipped in special shipping containers. Upon receipt of the meter, perform the following unpacking and inspection procedures. If damage to the shipping container is evident, be present when the meter is unpacked.

A) Carefully open the shipping container following any instructions that may be marked on the exterior. Remove all cushioning material surrounding the meter.

B) Carefully lift the meter from the container. Always use the lifting lugs provided for safety on meter sizes 10" and larger.



C) Retain the shipping box or crate and all packing materials for possible use in reshipment or storage.

D) Visually inspect the meter for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

NOTE: If damage is found, request an inspection report by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A formal claim for equipment damaged in transit is the responsibility of the customer.

E) Verify that the meter received is consistent with the product ordered. The detail on the product labels on the detector and the amplifier should help this verification.

F) All detectors with PTFE liner are shipped from the factory with a liner protector. This protector maintains the proper form of the PTFE material and protects it during shipping and storage. Do not remove this protector until you are ready to install the unit.

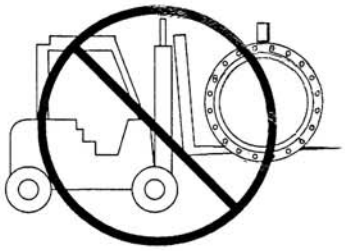
G) Storage: If the meter is not to be immediately installed, store it in its original container in a dry, sheltered location. Storage temperature: -4 to 158 °F (-20 to 70 °C)

TRANSPORTATION AND HANDLING

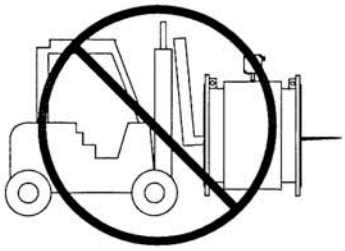
Do not lift the detector from the amplifier housing, the junction box or the connecting cable. As noted earlier, use lifting lugs for larger sizes.

Very large meter sizes are packed and crated with the meter laying on its side for shipping safety and stability reasons. In order to lift the meter in vertical position, it's recommended to use a sling rigged method as shown below.

If using a forklift, do not lift the detector from its body between the flanges. The housing could be accidentally dented and permanent damage could be caused to the internal coil assemblies.



IMPORTANT:
NEVER introduce the forks of a forklift, chains, wire slings or any other sharp object inside the flow tube for lifting or handling purposes. This could permanently damage the isolating liner and could render the meter inoperable.



METER INSTALLATION

METER LOCATION GUIDELINES

The following are several guidelines for determination of a good location for meter installation:

Temperature Ranges
In order to prevent damage to the meter, the maximum temperature ranges must be observed.

Primo® Amplifier
Ambient temperature: -4 to 140°F (-20 up to +60°C)

Meter with Meter Mount Primo
Fluid temperature: PTFE/PFA, -40 to 212°F (-40 up to +100°C)
Hard/Soft Rubber, 32 to 138°F (0 up to +80°C)

Meter with Remote Mount Primo
Fluid temperature: PTFE/PFA, -40 to 302°F (-40 up to +150°C)
Hard/Soft Rubber, 32 to 178°F (0 to +30°C)

Chemical Injection Applications
For water line applications with a chemical injection point, the meter should be installed upstream of the chemical injection point to eliminate any issues with the meter performance. If an upstream location is not possible for the meter, consider moving the injection point downstream of the meter location. If the meter must be installed downstream of the chemical injection point, the distance between these (2) locations must be significant; frequently 50 - 100 feet.

When the solution made up of the water and the injected chemical reach the Mag meter, it must be a complete homogeneous mixture. If too close, the Mag meter will sense (2) different liquids (conductivity different for each) and will be confused as to how to process the information. Many other factors such as the type of injection method, (spaced bursts versus continuous stream of drops), or whether the chemical is injected in a liquid or gas form, can cause a wide variation in the distance required from one application to another.

Due to this wide range of factors, it is difficult to specify a distance that will always work for any application without establishing a value far in excess of what would usually be required. Please contact Badger Meter's Technical Support at 1-800-616-3837 with your application detail and they can assist in determining if the Mag meter should properly perform. As noted, the meter may require 50 - 100 feet from the injection point to assure the complete homogeneous state.

Submersible Option
If the meter is to be installed in a meter vault, it should be ordered with the remote amplifier option to be sure the amplifier is not installed inside the vault. It is also recommended that the remote style meter package be ordered with the submersible option (Nema 6P). This will eliminate any potential problems from occurring should the vault become flooded or from any presence of humidity in the vault.

Other Considerations
Avoid all pipe locations where the flow is pulsating, such as in the outlet side of piston or diaphragm pumps.

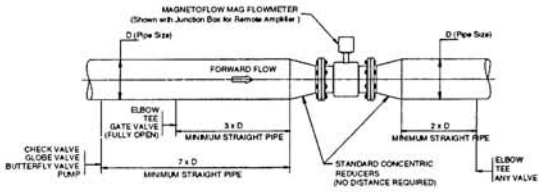
Avoid locations near equipment producing electrical interference such as electric motors, transformers, variable frequency, etc.

Install the meter with enough room for future access for maintenance purposes.

The mag meter isolating liner, whether if it is PTFE or Rubber, is not intended to be used as gasket material. Standard gaskets (not provided) should be installed to ensure a proper hydraulic seal. When installing the gaskets, make sure they are properly centered to avoid flow restriction or turbulence. Do not use graphite or any electrically conductive sealing compound to hold the gaskets in place during installation. This could affect the reading accuracy of the measuring signal.

STRAIGHT PIPE REQUIREMENTS

For optimum accuracy performance, it is required to provide sufficient inlet and outlet straight pipe runs. An equivalent to 3 diameters of straight pipe is required on the inlet side, and 2 diameters on the outlet side. There are no special requirements for standard concentric pipe reducers.



By using pipe reducers, a smaller meter size can be mounted in larger pipeline sizes. This may also increase low flow accuracy performace.

In order to minimize flow disturbances and excessive loss of head, custom fabricated pipe reducers must have a minimum slope angle of 15 degrees. If this is not possible, install the custom pipe reducers as if they were fittings, leaving the minimum straight pipe required.

Mounting Location
The detector should never be installed on the suction side of a pump where a vaccuum exists to eliminate the possibility of damage to the liner.

If vibration exits on the pipeline, secure the piping before and after the meter. If a strong vibration exists, the amplifier should be mounted remotely.

Remote Version
Do not install cables near power cables, electrical machines, etc.

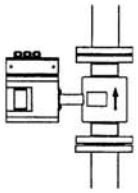
Be sure both ends of signal cable are securely fastened. Run power and signal cables in separate conduit.

METER ORIENTATION

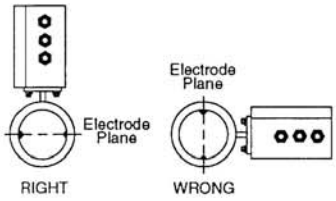
Magnetoflow® Mag meters can operate accurately in any pipe orientation and can measure the volumetric flow in the forward and reverse directions (note FORWARD FLOW direction printed on the detector label). The most recommended installation position is vertical piping, with the liquid flowing upward (see figure below).

This installation practice ensures two objectives:

1. The pipe remains completely full of liquid, even at low flow, low pressure applications with a discharge to the atmosphere.
2. Solid build-ups or sediments that could be part of the process fluid will not deposit or accumulate on the liner and/or electrodes.

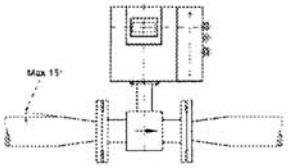


In horizontal piping orientation, the detector should be mounted in a position at which the measuring electrodes axis will remain in a horizontal plane (3 and 9 o'clock position; see figure below)



For very low flow rate applications, the flow rate can be increased by reducing the meter size and therefore the measuring accuracy can be improved.

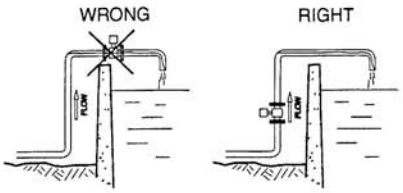
Pipe reducers can be mounted directly to the inlet and outlet of the meter. The reducer can not have an angle greater than 15°. The resultant pressure drop is negligible; in most cases less that 1 psi.

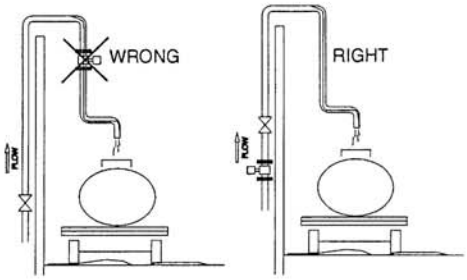


PARTIALLY FILLED PIPE SITUATIONS

Magnetoflow® mag meters are designed to operate in closed, full pipes.

It is relatively common to encounter situations where the process pipe will remain momentarily partially filled due to certain hydraulic conditions. Examples of this include discharge to the atmosphere (lack of back pressure), insufficient line pressure, gravity flow applications, etc.

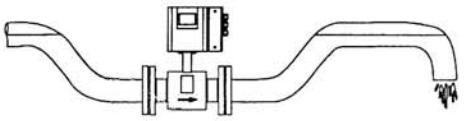




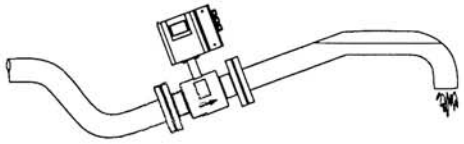
To eliminate the negative effect of these situations on the performance of the mag meter, observe the following guidelines:

- Avoid installing the detector in the highest point of the pipe line
- Do not install the detector in vertical, downward flow sections of the pipe
- ON/OFF valves should ALWAYS be located on the downstream side of the meter
- Select the recommended vertical orientation with flow upwards whenever possible
- Make sure that the flow range of the meter size selected is consistent with the application flow range

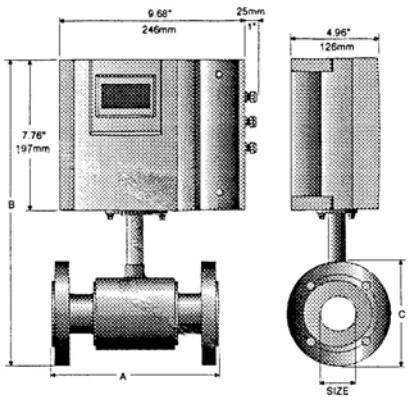
To minimize the possibility of partially full pipe flows in horizontal, gravity or low pressure applications, it is recommended to create a pipe arrangement as shown in the figure below. This arrangement ensures the detector remains full of liquid at all times.



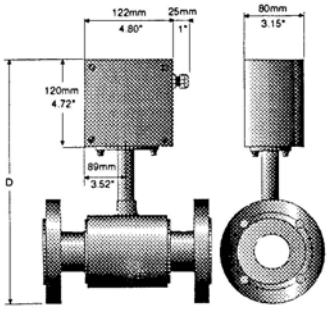
Open Discharge
Horizontal Installation



Open Discharge
Horizontal



Meter with Primo®



Meter with junction box for remote Primo®

Size		A		B		C		D		Est. Weight with Primo		Flow Range LPM		Flow Range GPM	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	Lbs	Kg	Min	Max	Min	Max
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.063	20	0.02	5
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.114	34	0.03	9
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.177	53	0.05	14
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5	0.416	125	0.11	33
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5	0.75	225	0.2	59
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0	1.20	350	0.3	93
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0	2.00	575	0.5	152
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5	3.00	900	0.8	239
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5	4.70	1400	1	373
2 1/2	65	11.0	280	17.1	434	7.0	178	14.4	366	54	24.5	8	2400	2	631
3	80	11.0	280	17.3	440	7.5	191	14.7	372	56	25.5	12	3600	3	956
4	100	11.0	280	18.4	466	9.0	229	15.7	398	58	26.5	19	5600	5	1493
5	125	15.8	400	19.6	498	10.0	254	16.9	430	60	27.0	30	8800	8	2334
6	150	15.8	400	20.6	524	11.0	279	17.9	456	62	28.0	40	12700	11	3361
8	200	15.8	400	22.5	572	13.5	343	20.4	518	88	40.0	75	22600	20	5975
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0	120	35300	30	9336
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0	170	50800	45	13444
14	350	23.6	590	30.8	782	21.0	533	28.2	716	260	118	230	69200	60	18299
16	400	23.6	590	33.7	856	23.5	597	31.0	788	308	140	300	90400	80	23901
18	450	23.6	590	35.0	890	25.0	635	32.4	822	287	130	380	114000	100	30250
20	500	23.6	590	38.2	969	27.5	699	35.5	901	495	225	470	140000	125	37346
22	550	23.6	590	39.6	1005	29.5	749	36.9	937	441	200	570	170000	150	45188
24	600	23.6	590	42.2	1071	32.0	813	39.5	1003	554	252	680	200000	180	53778
28	700	23.6	590	46.2	1173	36.5	927	44.0	1118	650	295	920	275000	240	73100
30	750	31.5	800	48.3	1228	39.0	984	45.7	1161	704	320	1060	315000	280	84000
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350	1200	361000	320	95600
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386	1500	457000	400	121000
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420	1900	565000	500	149300
42	1050	36.0	800	66.0	1675	53.0	1346	63.4	1610	1100	500	2100	620000	550	164600
48	1200	39.4	1000	69.9	1775	59.4	1455	67.2	1707	1210	550	2700	814000	720	215100
54	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620	3700	1100000	980	292700

SPECIFICATIONS - Detector

Flow Range: 0.1 - 39.4 fps (0.03-12 m/s)
Sizes: 1/4" to 54" (6 to 1400 mm)

Min. Conductivity: ≥ 5 micromhos/cm

Accuracy: ± 0.25% accuracy of rate from 1-33 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.

Electrode Materials: Standard: Alloy C
Optional: 316 Stainless Steel, Gold/Platinum Plated, Tantalum, Platinum/Rhodium

Liner Material: PTFE up to 24", Soft and Hard Rubber from 1" to 54", Halar® from 14" to 40"

Fluid Temperature:
With Remote Converter:
PTFE & Halar 311°F, (155°C)
Rubber 178°F, (80°C)
With Meter Mounted Converter:
PTFE & Halar 212°F, (100°C)
Rubber 178°F, (80°C)

Pressure Limits: 150 psi (10Bar) optional 300psi (20Bar)

Coil Power: Pulsed DC

Ambient Temperature: -4°F to 140°F, (-20°C to 60°C)

Pipe Spool Material : 316 Stainless Steel

Meter Housing Material: Carbon Steel welded

Flanges: Carbon Steel - Standard (ANSI B16.5 Class 150 RF)
316 Stainless Steel - Optional

Meter Enclosure Classification: Nema 4

Optional: Submersible Nema 6P (Remote Amplifier Required)

Junction Box Enclosure Protection: (For Remote Converter Option) Powder coated die-cast aluminum, Nema 4

Cable Entries: 1/2" NPT Cord Grip

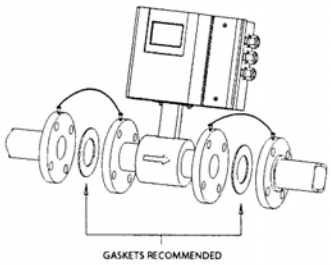
Optional Stainless Steel Grounding Rings:

Meter Size	Thickness (of one ring)
up thru 10"	.135"
12" to 20"	.187"

GROUNDING

IMPORTANT! In order to ensure proper operation, it is essential that the mag meter amplifier's input ground (zero voltage reference) will be electrically connected to the liquid media and to a good, solid earth ground reference.

Conductive Pipe Grounding



To achieve this, the meter body MUST be electrically connected to the liquid media. The mag meter flanges are provided with grounding bolts for this purpose.

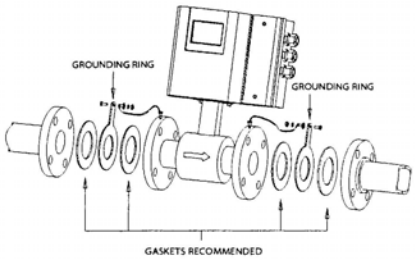
If the pipe material is electrically conductive, simply install grounding straps between these grounding bolts and the mating flanges.

To ensure a good electrical connection at the mating flanges, it is recommended to actually drill and tap the flanges to allow the installation of a grounding screw (not provided).

These grounding straps must be copper wire, at least 12AWG size, and must be connected on both sides (inlet and outlet) of the detector, and to a local earth ground.

IMPORTANT! If the process pipe is not electrically conductive (PVC, fiberglass or cement lined pipes) and the meter was not originally ordered with an optional grounding electrode, a pair of grounding rings must be installed between the mating flanges at both ends of the meter. See figure below.

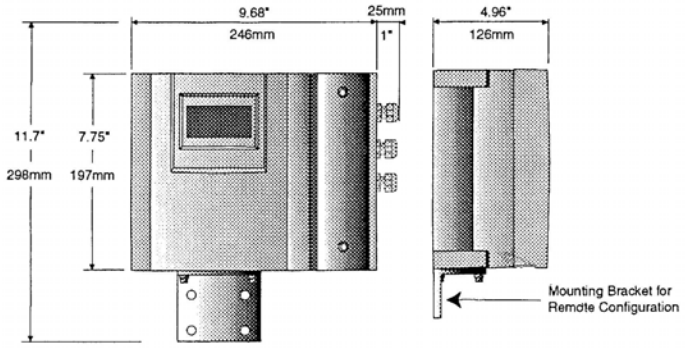
Non-Conductive Pipe Grounding



In this case, the grounding straps should be connected both to the grounding rings and to a good, solid earth ground.

Grounding rings are availabe in stainless steel. If your fluid to be measured is too aggressive for stainless steel, order meter with the optional grounding electrode in material option that will be compatible with the fluid.

PRIMO® AMPLIFIER (3.1 ELECTRONICS)



SPECIFICATIONS

Power Supply: 85-265 VAC, 45-65 Hz
Power Consumption: 20W
Accuracy: ± 0.25% accuracy of rate from 1-39.4 fps.
± 0.5% accuracy of rate from 0.1-1.0 fps.
Repeatability: 0.1%
Minimum Fluid Conductivity: 5.0 micromhos/cm
Flow Direction: Unidirectional or bidirectional, 2 separate totalizers (programmable)
Analog Outputs: 0/4-20mA, 800ohms Max Load
Ouput Frequency: Scaled Pulse output, (open collector) Max 5Khz
Digital Outputs:
Voltage sourcing transistor, 24VDC, 100mA max
(3) AC electro-mechanical relays, 48VAC, 0.5 amp max
Outputs: All ouputs are short circuit safe

Noise Dampening: Programmable from 1 to 6
Pulse Width: Programmable up to 500ms
Galvanic Isolation: ≤ 500V
Zero-point Stability: Automatic correction
LCD Display: 4 lines x 16 character back-lit alphanumeric
Displays (2) Totalizers, Flow Rate, Alarm conditions
Housing: Cast aluminum, powder coated paint
Housing Rating: NEMA 4X
Mounting: Detector mount or remote mount (bracket supplied)
Cable Connection: 1/2" NPT Cord Grip
Ambient Temperature: -4 to 140° F (-20 to 60° C)
Serial Communication: RS232

WIRING

At installation, be sure to comply with the following requirements:

IMPORTANT!

- Disconnect power to the unit before attempting any connection or service to the unit
- Do not bundle or route signal lines with power lines
- Keep all lines as short as possible
- Use twisted pair shielded wire for all output wiring
- Observe all applicable local electrical codes

For the AC power connections use three wire sheathed cable with overall cable diameter of 0.2" to 0.45" (5mm to 12mm). For signal output use 18 to 22 gauge (0.25 mm² to 0.75mm²) shielded wire. Overall cable diameter between 0.12" to 0.35" (3mm to 9mm).

WIRING FOR REMOTE PRIMO® CONFIGURATION

Wiring between the detector and the Primo amplifier comes complete from the factory. If your installation requires the use of conduit, the following are recommended steps for wiring of the detector to the amplifier.

1. Remove the junction box lid. Carefully remove the wires connected to the terminal blocks that run to the Primo amplifier. Note which wire goes into which terminal. The chart below may be of assistance for reference of wire color and terminal connection.

2. Run cable through conduit from Primo amplifier location, retaining the wiring of the cable to the amplifier as supplied.

3. Complete conduit assembly on both ends and rewire cable into junction box as wired when received. See wiring diagram below.

Connection No.	Description	Wire color
11	Coil	Green
12	Coil	Yellow
13	Main Shield	Yellow/green
45	Electrode	White
44*	Electrode Shield	Black
46	Electrode	Brown
40	Empty Pipe	Pink
44*	Empty Pipe Shield	Black

*Connections with the No. 44 are lying on the same potential

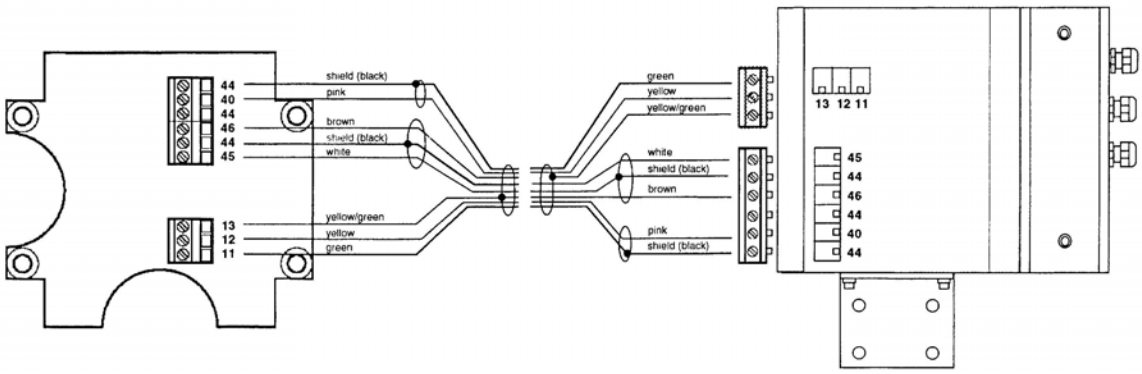
Remote style Primo Amplifier models can be ordered with longer cable than our standard stock lengths of the standard cable; 15, 30, 50 and 100 feet. The following chart shows the cable style options and the maximum flow medium temperature that can exist in the application environment at a given length of that cable.

		Cable Size		
		Standard	Medium	Large
		AWG 23	AWG 20	AWG 18
		0.25mm²	0.50mm²	0.75mm²
		Fluid Temperature		
Cable Length (Ft)	100	311F	311F	311F
	125	306F	311F	311F
	150	294F	311F	311F
	175	283F	311F	311F
	200	271F	311F	311F
	225	260F	312F	311F
	250	249F	306F	311F
	275		300F	311F
	300		295F	311F
	325		289F	311F
	350		283F	311F
	375		278F	309F
	400		272F	305F
	425		266F	302F
	450		260F	298F
	475		255F	294F
	500		249F	291F

Empty Pipe Detection Considerations

Cable Length (ft)	Minimum Conductivity Required (µS/cm)
0 (Meter Mount)	5
100	20
500	100

Wiring for Remote Primo Configuration



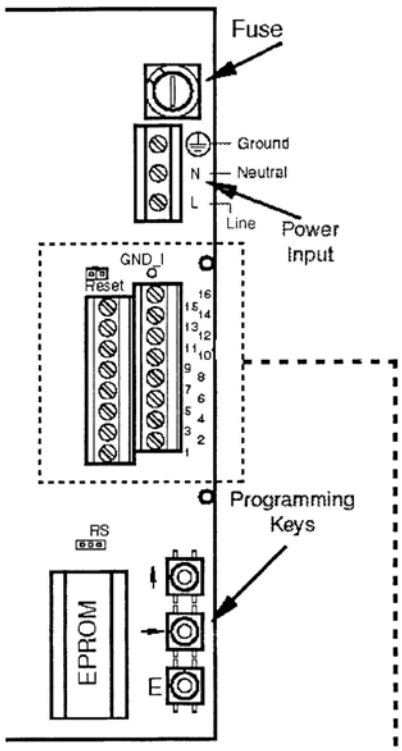
WIRING INPUTS AND OUTPUTS TO THE PRIMO® AMPLIFIER

Once the wiring between the sensor and the amplifier is done proceed to wire any inputs and outputs to the Primo amplifier.

IMPORTANT! For safety reasons leave AC power connections to the unit as the last step. Follow all the safety precautions and local code to prevent electrical shock and/or damaging of the electronic components.

1. Loosen the two bolts on the red amplifier cover. Remove the cover. Inside the amplifier you will see a terminal strip similar to the one depicted in the figure to the right.

Board Accessible with Red Cover Removed



POWER

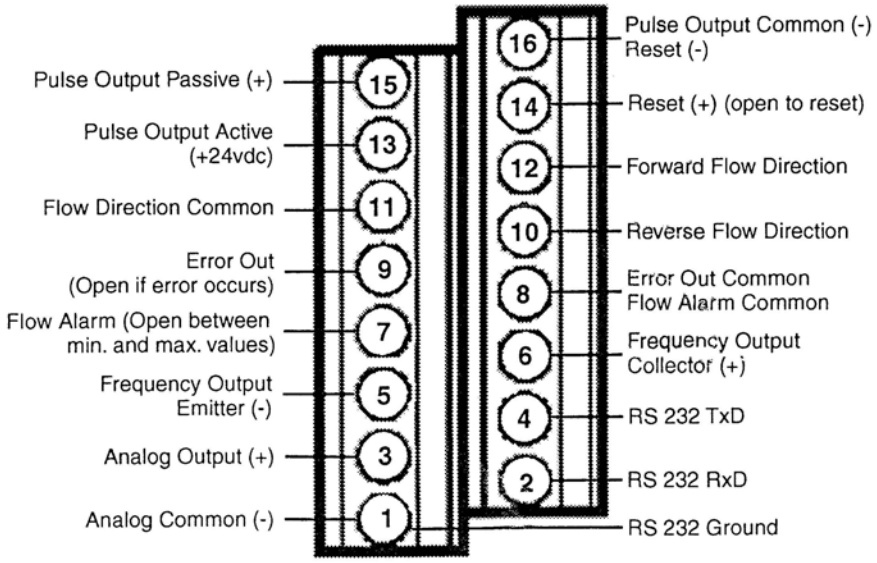
⚠CAUTION
To prevent accidents, power connection should be made only after all other connections have been completed.

The PRIMO amplifier is a microprocessor based device. **It is important that the power supply be as "clean" as possible.** Avoid using power lines that feed heavy loads such as pumps, motors, etc. If dedicated lines are not available, a filtering or isolation system might be required.

It is recommended that the internal fuse protection be maintained. Use a 2 amp slow blow fuse.

How to connect the amplifier to remote digital indicators/totalizers that do not require external power supply
This connection is intended for use with indicators that do not require an external power supply such as the ER series indicators from Badger Meter. For the ER-6, ER-8 or ER-9, connect terminal 15 of the Amplifier to terminal 2 of the ER series and terminal 16 to ground or terminal 1 of the ER indicator.

For connection to the PC 100 Controller, connect terminal 15 of the amplifier to terminal 14 of the PC 100 and terminal 16 of the amplifier to terminal 12 of the PC 100.



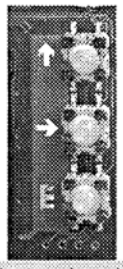
PROGRAMMING (3.1 Electronics)

The Primo® amplifier comes preprogrammed from the factory and in most instances will not require any additional manipulation. However, if you will be using the flow signal outputs or need to reprogram the meter to suit your particular needs, it will be necessary to familiarize yourself with the programming procedures.

Programming of the Primo amplifier is very simple
This section gives step by step instruction on how to program each of the functions of the amplifier and an explanation of the choices that are available for each one.

First, using a small flat screwdriver, remove the red cover from the main amplifier housing. At the lower right corner of the unit you will see three square buttons. These buttons are used to perform all programming procedures.

Programming Keys



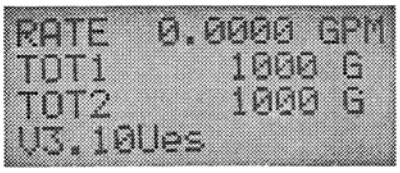
NOTE: The programming buttons have been placed inside the amplifier enclosure to prevent tampering or accidental reprogramming of the unit. After programming, be sure to reassemble the red cover on the enclosure.

The four line 16 digit LCD display of the Primo amplifier will guide you through each of the programming options/steps. The main screen will display:

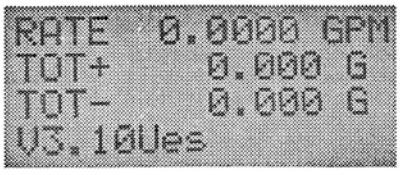
1st Line:	Flow Rate
2nd Line:	Totalizer (TOT+ or TOT1)
3rd Line:	Totalizer (TOT- or TOT2)
4th Line:	Displays revision of software to assist in troubleshooting. This line is also used to display any error messages that may occur during operation of the meter.

The main display screen will be in one of the following modes. (See Flow Direction on page 11 for additional detail.)

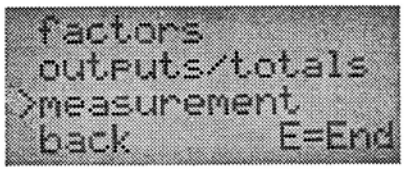
Uni-Directional Mode



Bi-Directional Mode



By pressing the Enter or E key (bottom key), you will be at the main submenu screen. If no entry is done within 5 minutes while in any of the programming parameters, the program returns automatically to the main screen. Even during the parameter setting mode, the meter will be measuring and totalizing any flow that occurs.



There are three main submenus: factors, outputs/totals and measurement. Each submenu gives access to the following appropriate functions:

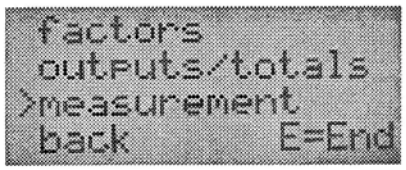
Factors:
1) Detector factor
2) Pipe diameter
3) Password protection

Outputs/Totals:
1) Reset totals
2) Analog outputs
3) Pulse outputs
4) Frequency
5) Flow alarm

Measurement:
1) Unit
2) Full scale
3) Low flow cutoff
4) Empty pipe detection
5) Flow direction
6) Filter
7) Error list

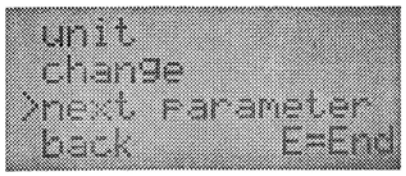
PROGRAMMING OF MEASUREMENT PARAMETERS

When the programming submenu screen appears, notice the right arrow on the far left side. Using the up ↑ arrow key, you can position the arrow in front of the submenu that you wish to interrogate. We recommend starting with the "measurement" submenu followed by the "outputs/totals" submenu and finally the "factors" submenu.



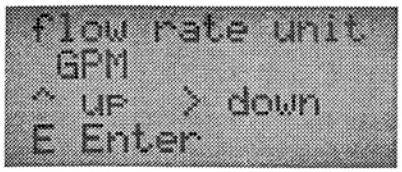
Use the ↑ key to position the > arrow next to "measurement" and press the → key. The following screen will appear:

UNIT OF MEASURE



This is where you will select the unit of measurement for the flow rate indication and the totalizers. Use the ↑ key to place the → arrow next

to "change" and press → key. The first unit of measurement screen will appear:



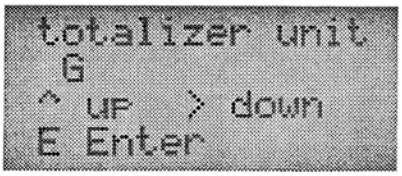
Using the ↑ or→ keys,select the desired unit of measure for flow rate indication.

Choices are:

L/h	Liters/hour
L/m	Liters/minute
l/s	Liters/second
m³/h	Cubic meters/hour
m³/m	Cubic meters/minute
m³/s	Cubic meters/second
GPM	US gallons/minute
MGD	US million gallons/day
LbM	US liquid pounds/minute
oz	US fluid ounces/minute
IGM	Imperial gallons/minute

The existing totalizer values are automatically converted into the selected unit of measure.

After selecting unit of measure for flow rate, press Enter. You will see the following screen for selecting unit of measure for the totalizer.



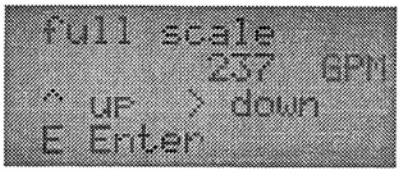
Choices are as follow; any existing values on the totalizers will automatically be converted into the new selected unit of measure

L	Liter
m³	Cubic meter
G	US gallons
MG	US million gallons
Lb	US liquid pounds
oz	US fluid ounces
IG	Imperial gallons
aft	Acre feet
ft³	Cubic feet

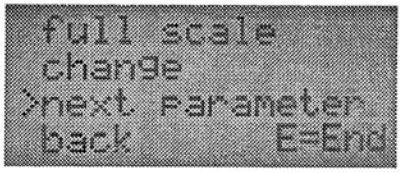
After the totalizer unit of measure selection, press the E key the following screen will appear:

FULL SCALE (MAXIMUM FLOW)

If you changed the unit of measure, the full scale or maximum flow may also need to be changed to reflect the maximum flow rate with the new unit of measure. **This is a very important parameter as it relates to other parameters including frequency output, low-flow cut-off, alarm outputs and analog signal outputs.** Adjust the desired new full scale setting based on your meter size and your applications requirements, making sure that it falls within the suggested flow range of the meter.



When done, press enter and then the → key and the next parameter will appear.



This is the same full scale parameter as previously visited. It is positioned here to provide ability to change full scale setting if no unit of measure change is necessary.

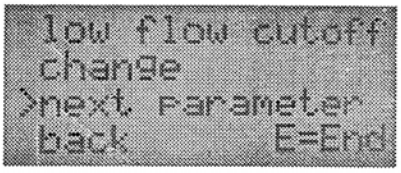
The full scale can be chosen in a range of 0.4 up to 39.4 ft/sec. A flow value is assigned to the analog output as well as the frequency output by the full scale scaling. The scaling is valid for both flow directions.

NOTE: If the flow rate is exceeding the full scale setting by more than 5%, an error is indicated that the selected full scale range is exceeded. (Terminals 7 and 8)

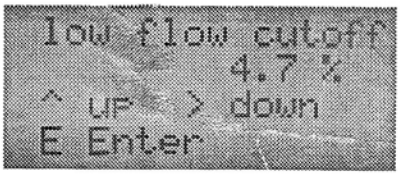
Once this is done, press E and then the → key and the next parameter will appear:

LOW FLOW CUTOFF

This is the low flow cutoff function. It is used to assign a low flow rate at which measurement will stop, preventing measurement and thus totalization errors. This parameter can be programmed from 0 % up to 10% of selected full scale flow rate.



Place the > arrow next to "change" and then press the → key. The following screen will appear:



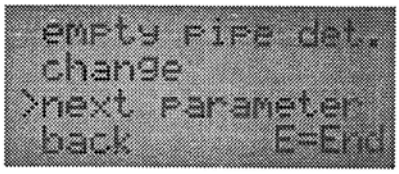
The factory setting is 0.2%. Increasing this value will help prevent false readings during "no flow" conditions due to fluid movement in the pipe caused by vibrations or piping arrangements.

Using the ↑ and → keys select a value and then press ENTER.

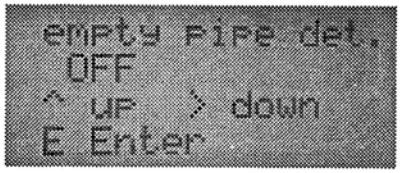
Press → key and you will see the next parameter:

EMPTY PIPE DETECTION

The empty pipe detection parameter when programmed to be ON will provide an error relay indication if the meter is partially filled with liquid. This will also show an empty pipe error message on the display.



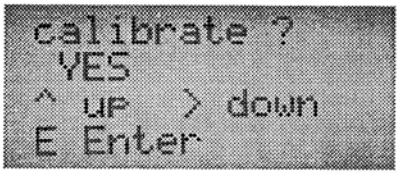
Position the > next to "change" and press the → key. The following screen will appear:



NOTE: The empty pipe detection can be calibrated if required if the fluid conductivity is different than water or the remote cable length is significantly changed.

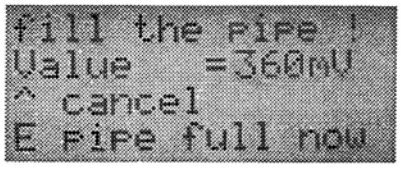
Use the ↑ and → keys to turn the feature ON or OFF as desired.

If off is selected, hit ENTER and then the →key to go to the next parameter. If ON is selected, hit ENTER and the following screen will appear:

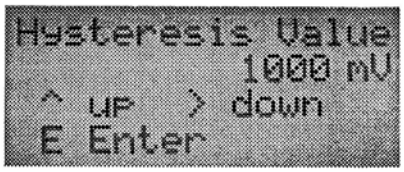


To proceed with calibration, leave "YES" selected and hit ENTER for the next screen.

The pipe has to be filled with the media that will be measured by the meter. A value between 0 and 5000 mV will be measured and displayed. The value increases with decreasing conductivity, increasing cable length or size. For normal water, the value should be between 10mV and 500mV. Afterwards the signal difference between full and empty pipe is determined by the hysteresis value.



Make sure your pipe is full of fluid and when ready, hit ENTER. This new screen is the hysteresis value entered. This value is set at the factory at 1000 mV to allow some variation in empty pipe detection to eliminate the potential for false "empty pipe signals." It is not necessary for this value to be changed.



When calibration is complete, hit ENTER.

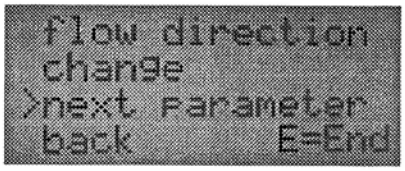
The switching threshold for the empty pipe detection is when the measuring signal "full pipe" plus hysteresis value is exceeded (i.e. = 360 mV+ 1000 mV). The maximum value for the switching threshold is at 4000 mV.

If full pipe calibration value is higher than 3000mV, please contact customer service for assistance.

Hit →key for next parameter screen:

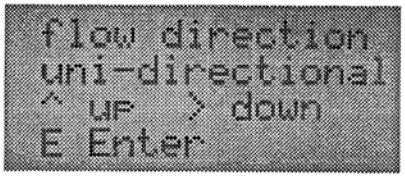
FLOW DIRECTION

The flow direction can be programmed to uni- or bi-directional modes.

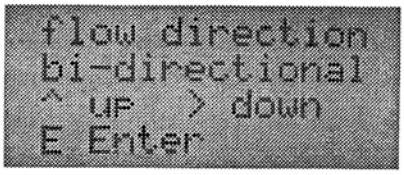


Place the > next to "change" and press the → key. One of the following (2) screens will appear:

Uni-directional totalizes the flow only in one direction (flow direction on the detector label). If the fluid is flowing in the opposite direction, the counter will indicate zero on the display and no outputs. Both totalizers can be used as resettable counters in this mode. The totalizers are indicated as "TOT1" and "TOT2".

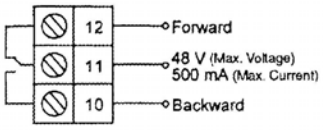


The bi-directional setting measures the flow in both directions. The first totalizer (TOT+) is measuring in the forward flow direction and the second totalizer (TOT-), the reverse direction. A change of flow direction is indicated via the flow direction relay.



Relay Wiring Terminals

Flow Direction Relay

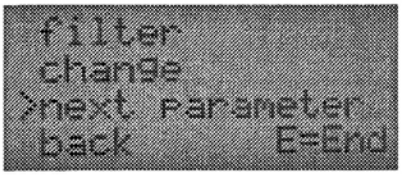


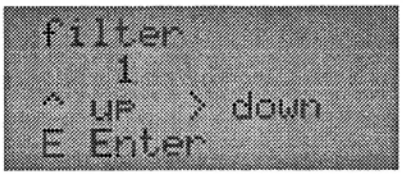
Using the ↑ and → key select which flow direction mode you want and press ENTER. Hit the → key to go to the next parameter.

FILTER DAMPENING

This feature is for dampening of all output signals and flow rate display. This function has no effect on the totalizers.

The factory setting is 1. If you notice too much back and forth oscillation of the flow rate indication, increase this value incrementally until the display is more stable. Your choices are 1 though 6 or "Inactive." To change the filter value, place the arrow next to "change" and press the → key. The following screen will show:

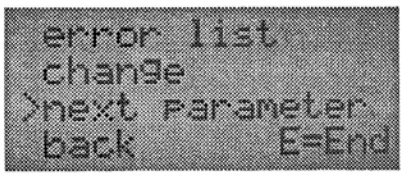




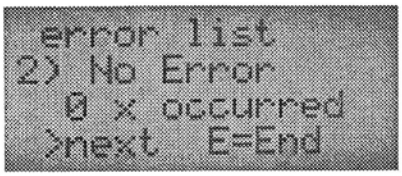
Using the ↑ and → keys select the desired filter value and then press ENTER. Hit → key to go to last parameter of this submenu.

ERROR LIST (MESSAGES)

The error list in the program menu indicates the last 8 error types that have occurred and the frequency of each. The sum of all switching on processes can be read on the "Power Up - Counter." This can assist in checking possible power failures.

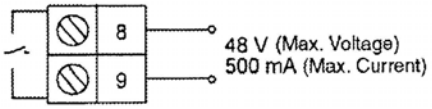


Line up the > with "change" and hit the → key. This will bring up the 1st error. Continue hitting the → key to toggle through the last 8 errors that occured, with #1 being the most recent error and the power-up indication screens.

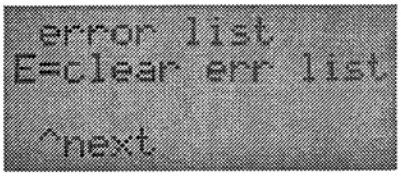


Any error is indicated via the error relay as well as displayed on line 4 of the LCD display. The relay is normally closed during normal operation and is opened when an error occurs.

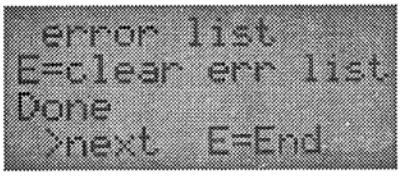
Error Relay



Now hit the → key again and you will be at the screen for clearing all the error list information.



Hit Enter to clear and the following screen will appear with "Done" indication.



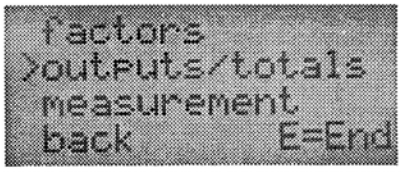
An overview of the possible errors and causes can be found in the Troubleshooting section.

Now hit enter twice and you will be back at the submenu screen.

PROGRAMMING OF OUTPUTS/TOTALS PARAMETERS

The next submenu is outputs/totals.

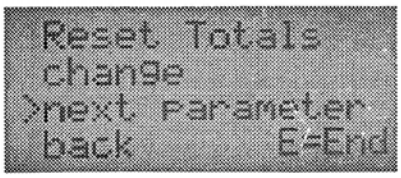
From the main submenu screen, position the > next to the "outputs/totals" submenu and press the → key.



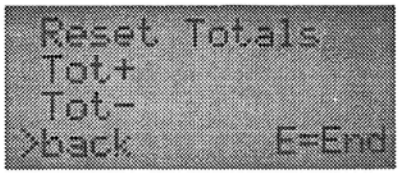
The following screen will appear:

RESETTING OF TOTALIZERS

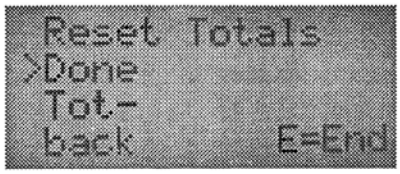
This parameter is used to reset either of the totalizers to zero.



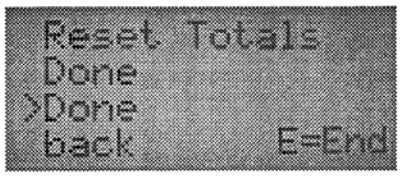
Line up the > with change and hit → key.



Now line up the > next to the totalizer you wish to reset. Hit → key and that totalizer will now indicate "DONE."



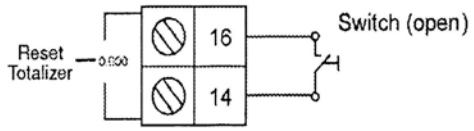
If desired to reset the other totalizer, repeat the same steps.



The "TOT2" totalizer in the uni-directional flow mode, can be reset externally.

The following is the wiring connections diagram for external reset.

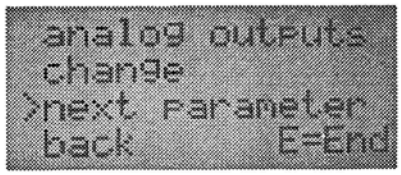
External resetting



When finished, hit Enter. Hit → key to go to the next parameter.

ANALOG OUTPUTS

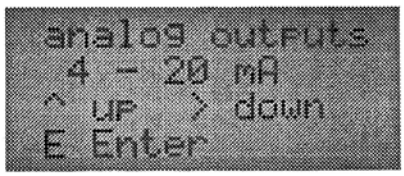
This parameter is for selection of the desired analog output and also calibration if required.



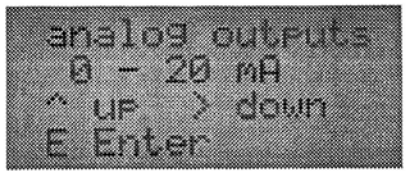
The following are the options available for the analog output ranges.

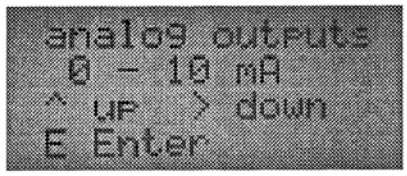
4 to 20 mA
0 to 20 mA
2 to 10 mA
0 to 10 mA

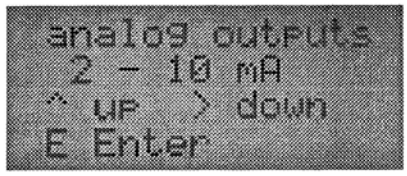
Press the →key at the "change" line the following screen will appear:



Press ↑ or → keys until you find the type of analog output that you desire among the following screens:

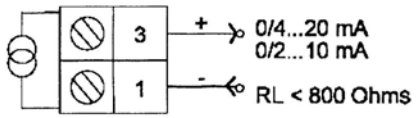




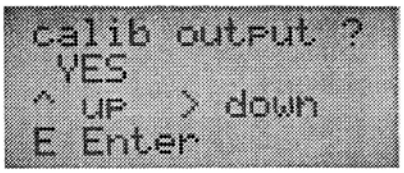


NOTE: The flow value is limited to 105% of the programmed full scale value. If this value is exceeded, an overflow error will appear on the LCD display. In bi-direction operation, the flow direction is indicated via the flow direction relay. The following diagram illustrates wire connections for the analog ouput signal.

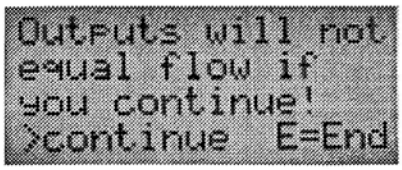
Analog output (active)



Once you have selected the output, press the ENTER key to select that particular output. You will then be at the calibration screen. You should calibrate the analog output after you have it connected to your PLC or chart recorder.

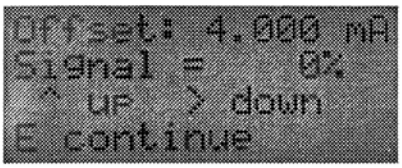


If calibration is in fact desired, hit ENTER again to get to the following screen:

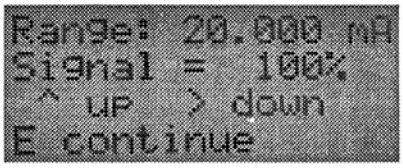


This is an important reminder to make sure that if the meter is part of a closed loop system, you must put the system in manual operation while performing the calibration process.

Hit the → key to continue and this screen will apprear:



Hooking up an amp meter in series with the connected chart recorder (Terminals 1 and 3), you may use the ↑ and → keys to calibrate the 4mA signal for "0" flow. Hit ENTER to continue.



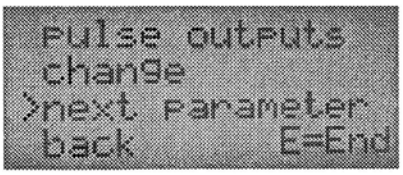
Now the 20 mA signal may be calibrated for 100% flow based on maximum flow rate set in programming.

NOTE: When you use a different analog output setting than 4-20mA, (i.e. 0-20mA) that the output calibration will still be performed with 4-20mA and applied to the selected setting (i.e. 0-20mA).

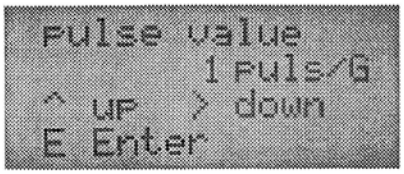
Hit ENTER to complete calibration and the → key for next parameter.

PULSE OUTPUTS

The pulse output parameter will determine how many pulses per gallon, liter, etc. will be sent out to remote counters, controllers, etc. It will also set how many decimal digits will be displayed on the totalizers. If, for example, you choose 100 pulses per gallon, then the display totalizers will have two digits after the decimal point.

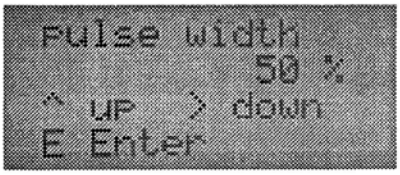


Move the > arrow next to "change", then press the → key and the following screen will appear:

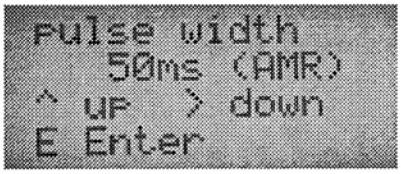


Use the ↑ and → keys to change the value to the desired pulse rate. This value may be set from .001 to 10,000 pulses/unit of measure. Maximum frequency of 10kHz can not be exceeded. Based on maximum flow rate setting, the program will not permit a value that exceeds this frequency.

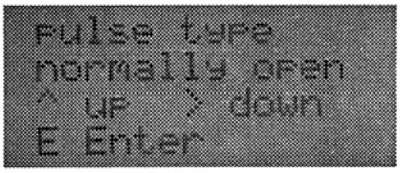
Press ENTER when you have programmed the desired number.



This parameter is pulse width, or the time duration that each pulse will be "ON". The 50% setting means 50% on 50% off. You can set the width in increments of 5 ms from 5-500 ms. The factory setting is 20 ms. Program this parameter to match the required pulse width of the remote accessory that will receive the pulse output. For output to any AMR device, see steps below.



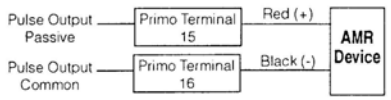
Hit enter and the next screen is:



This parameter permits changing of the factory setting of "Normally Open" for the pulse output to "Normally Closed." After complete, hit enter and the → key for the next parameter.

WIRING OF AMR UNIT TO MAG METER

AMR Wiring Diagram

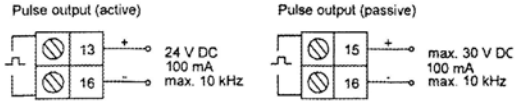


Step 1: Check to make sure your pulse output settings are correct per chart.

Maximum Flow Rate	Pulse Output Setting
Less than 5500 gpm	1 pulse per 100 or 1000 gallons
Greater than 5500 gpm	1 pulse per 1000 gallons
Less than 5500 Cu. Ft./min.	1 pulse per 100 or 1000 Cu. Ft.
Greater than 5500 Cu. Ft./min.	1 pulse per 1000 Cu. Ft.

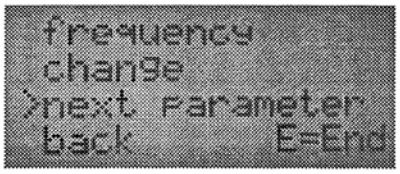
Step 2: Set pulse width to "50 ms (AMR)"
Step 3: Set pulse type to "normally open"

The following diagram is for other wiring connections for pulse outputs.

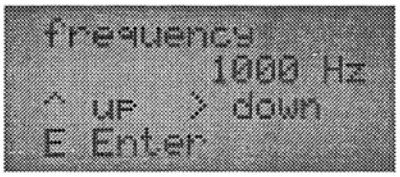


FREQUENCY OUTPUT

This is the Frequency Output parameter. The setting can range from 500 Hz up to 5000 Hz for the Full Scale Value. (Example: If 1600 Hz is selected, then when meter display indicates full scale value, this output is equal to 1600 Hz).

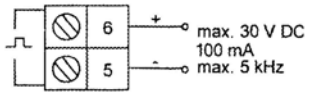


If a change is desired, line up > cursor with change and hit → key.



When complete, hit Enter.

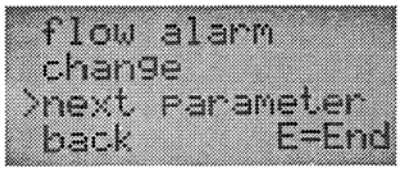
Frequency output (passive)



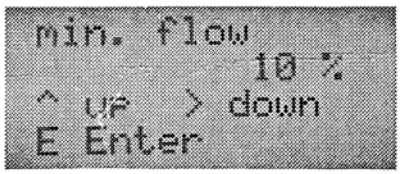
Hit → key for next parameter.

FLOW ALARMS

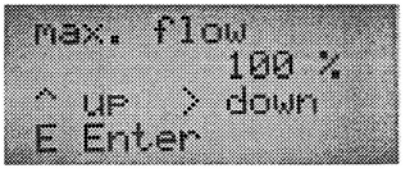
This parameter allows the setting of a minimum and maximum percentage (%) of the Full Scale flow rate value. Settings can be made in 1% increments from 0 to 100%. The minimum value must be smaller than the maximum value.



Move the > next to "change" and press the → key. The following screen will appear:



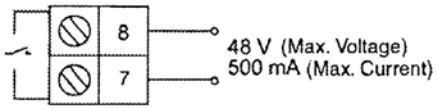
Use the ↑ and → keys to select the minimum flow percentage and press ENTER; the following screen will appear:



Use the ↑ and → arrows to change the maximum flow percentage and press ENTER.

NOTE: On the signal output, the relays will remain energized until the flow rate returns to within the flow limits.

Flow Alarm Relay

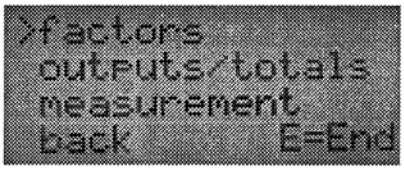


Press ENTER again to return to submenu screen.

PROGRAMMING OF FACTORS PARAMETERS

The third and last submenu "Factors" contains parameters that usually do not require changes.

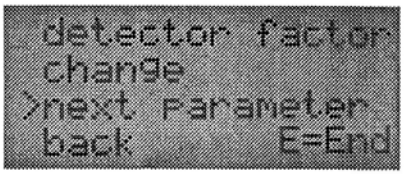
Press ENTER until you reach the submenu screen if not already there.



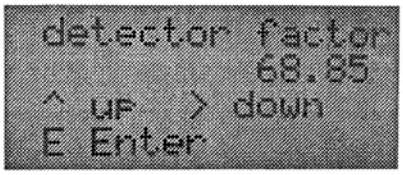
Position the > next to the "factors" submenu and press the → key. The following screen will appear:

DETECTOR FACTOR (FIELD CALIBRATION)

This is the Detector factor setting. When the meter was calibrated, this value was programmed in this parameter as a result of that calibration. Each detector has its individual factor. This detector factor is also included on the label of the meter body.



Line up the > with "change" and hit → key. This is the detector factor setting.



With this parameter, you can fine tune your calibration to meet your applications needs. If you find that the meter is off by a certain percentage, you can modify the detector factor to achieve the desired accuracy.

Even though all meters are calibrated at the factory, sometimes your specific installation and fluid parameters make it necessary to recalibrate a meter under actual operating conditions with the liquid being metered.

The following instructions are provided to assist in performing an on-site calibration check and adjustment. This procedure may require either a test tank or vessel of known capacity or a second flow meter installed in the same line.

ACCURACY TEST

1. Place a test tank of calibrated volume at the output of the meter.
2. Operate meter until test tank is filled to the appropriate calibrated level. Since meter accuracy can vary somewhat with flow rate, we recommend making test run at the same flow rate used in actual operation.
3. Record quantity indicated on display totalizer.
4. Repeat run three times and calculate an average for the (4) tests.
5. Perform the following calculation to determine the percent of accuracy of the meter.

$$\frac{\text{Qty. Delivered in vessel}}{\text{Average Meter Reading}} \times \text{Old Detector Factor} = \text{New Detector Factor}$$

Example 1.

$$\frac{100 \text{ Gallons}}{95 \text{ Gallons}} \times 68.85 = 72.47$$

In this example, the meter accuracy is low and must be increased by a calibration correction.

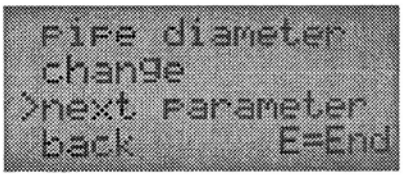
Example 2.

$$\frac{100 \text{ Gallons}}{104 \text{ Gallons}} \times 68.85 = 66.20$$

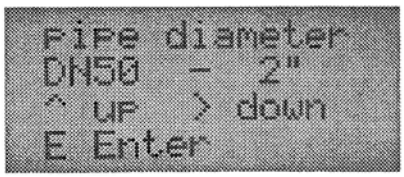
In this example, the meter accuracy is high by 4% and must be reduced by a calibration correction.

When finished with detector factor parameter, hit ENTER and then hit → key to go to the next parameter.

METER/PIPE SIZE



Place the arrow next to "change" and press the → key. The following screen will show:



This parameter will come preprogrammed from the factory matching the line size of the detector. However, if you replace the entire amplifier in the field, you may need to reprogram this parameter.

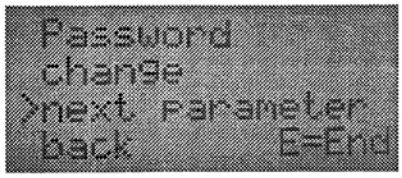
Select the pipe diameter of your flow meter by using the ↑ and → keys to match your meter size.

When complete, press Enter.

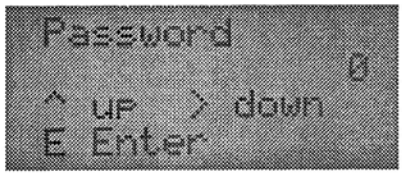
Hit → key to go to the next parameter.

PASSWORD PROTECTION

This is the password protection parameter. The unit will be set at "0" (no password required) from the factory. If activated, whenever you want to go into any of the submenus, the unit will ask for the password number.



To activate the password, line up the > with "change" and hit → key.

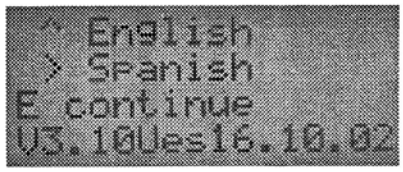


Change "0" to any desired number from 1 to 999. Hit enter and after returning to the main screen, you will always have to enter the new password to get into the submenus. If the password is lost or forgotten, a factory "333" password value can also be used to satisfy the password entry. If later no password is desired, change the value back to "0", hit Enter and a password will no longer be required to enter any of the submenus.

Hit ENTER twice and you will be back at the main screen.

LANGUAGE SELECTION

The software permits the selection of English or Spanish languages. To change the language, switch off power to Primo Amplifier. While holding the ENTER key down, re-power the unit. Hit ENTER to get to the following screen:



Select desired language and hit ENTER several times until main menu screen appears.

TROUBLESHOOTING

The Magnetoflow® mag meter should give you many years of maintenance free operation. However, should it malfunction, there are certain things that we recommend you check before contacting our technical support department or your local Badger® Representative.

Note: If the fluid measured has a high concentration of conductive solids, deposits may accumulate on the internal liner walls and electrodes. These deposits will cause a reduction of the measuring output. Thus, it is recommended to remove the meter and inspect the liner and electrodes after 6 months. If deposits are found, remove them with a soft brush. Repeat inspection process every 6 months or until an appropriate inspection cycle, (likely longer) can be established for the specific application. Some general conditions as follows:

DESCRIPTION	POSSIBLE CAUSE	RECOMMENDED ACTION
Flow is present but display is "0"	Signal cable not connected.	Check signal cable.
	Detector mounted opposite of the main flow direction (see arrow on the nameplate).	Turn detector by 180° or switch terminal 45 and 46 or reprogram to biodirectional mode.
	Coil or electrode cables exchanged.	Check cable connections for cross wiring.
Inaccurate measuring	Parameter wrong.	Check the parameters (transmitter, detector factor and size) according to attached data sheet.
	Pipe not fully filled.	Check if meter is fully filled.
No display	No power.	Apply power.
	Incorrect power.	Check power value.
	Wiring connections.	Check power input/output connections.
	Fuse blown.	Replace fuse. (2 Amp slow blow 5 x 20 mm)
Flow rate value known to be wrong	Maximum flow rate setting.	Change setting.
	Detector Factor.	Check value on label.
	Deposits on electrodes and/or liner.	Check and remove deposits.
	Incorrect pipe size programmed.	Check size if necessary.
Flow rate indication unstable	Filter value too low.	Increase filter value setting.
	Cable issue.	Make sure cable is shielded and not vibrating.
	Grounding issue.	Make sure meter is properly grounded to a good earth ground.
	Partially full pipe.	Make sure pipe is full of fluid.
	Air.	Make sure fluid does not contain air bubbles.
	Amplifier location - outside electrical interference.	Make sure amplifier is not too close to sources of electrical interference.
	Chemical injections.	Check location of injection in relation to location of meter.

ERROR MESSAGE EXPLANATION

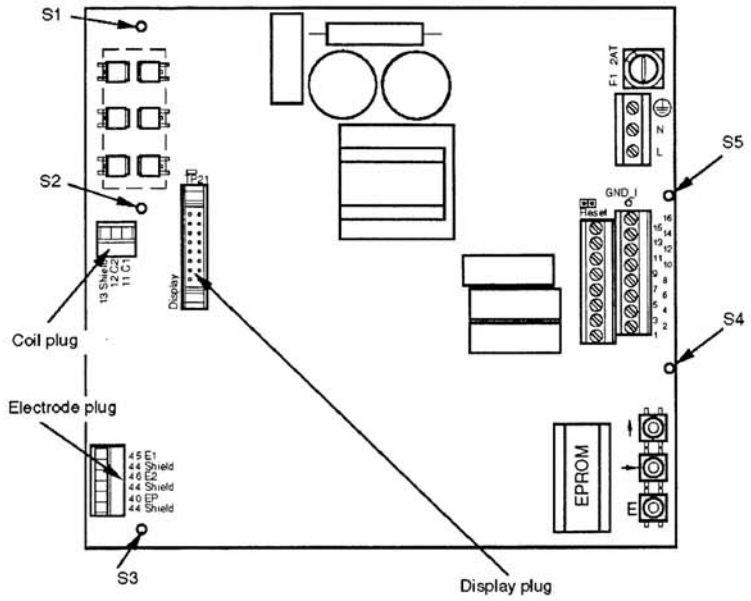
Some general conditions to keep in mind: When certain connections are sensed by the electronics, the following error messages can be indicated on the display (line 4) as well as on relay 3. The relay is closed during normal operation and is opened by an error appearing.

The following error messages can appear:

ERROR MESSAGE	POSSIBLE CAUSE	RECOMMENDED ACTION
Err: Detector	No detector connection with amplifier.	Check detector and cable connections in accordance with Instruction Manual.
	Connection between amplifier and detector interrupted.	Contact Technical Support.
	Supply voltage too low.	Contact Technical Support.
	Grounded coils in meter.	Contact Technical Support.
	Water in detector.	Contact Technical Support.
Err: Output	Micro processor output control defective.	Contact Technical Support.
Err: unknown	Program error.	Contact Technical Support.
Err: empty pipe	Pipe may not be full.	Make sure all trapped air is out of system. If fluid or fluid conductivity recalibrate the parameter.
Err: full scale	Actual flow rate is exceeding the programmed full scale value by more than 5%.	Reduce flow rate or increase the programmed full scale value.
Err: AD-Range	AD-Converter is exceeding signal limits.	Check the grounding scheme of the meter installation. See grounding section in manual.
Err: AD-Init	Initialization of AD-Converter unsuccessful.	Contact Technical Support.

If additional assistance is required, please contact our **TECHNICAL SUPPORT department at 1-800-456-5023** or contact your local Badger® Representative.

COMPLETE BOARD ASSEMBLY REPLACEMENT



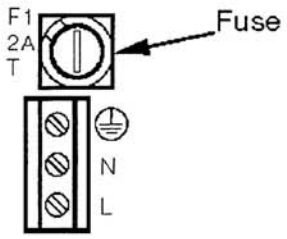
⚠WARNING
Make sure power to Primo® amplifier is off before proceeding.

1. Pull the electrode, coil and display wiring plugs. Loosen the screws S1 to S5 and remove the existing board assembly.
2. Put in new board assembly and reassemble screws to S1 and S5. Reinstall the (3) wiring plugs.
3. Program the new board assembly with the previous detector factor and meter size.

FUSE REPLACEMENT

⚠WARNING
Make sure power to Primo amplifier is off before proceeding.

Fuse type: 250 V, 2 A (time-lag)



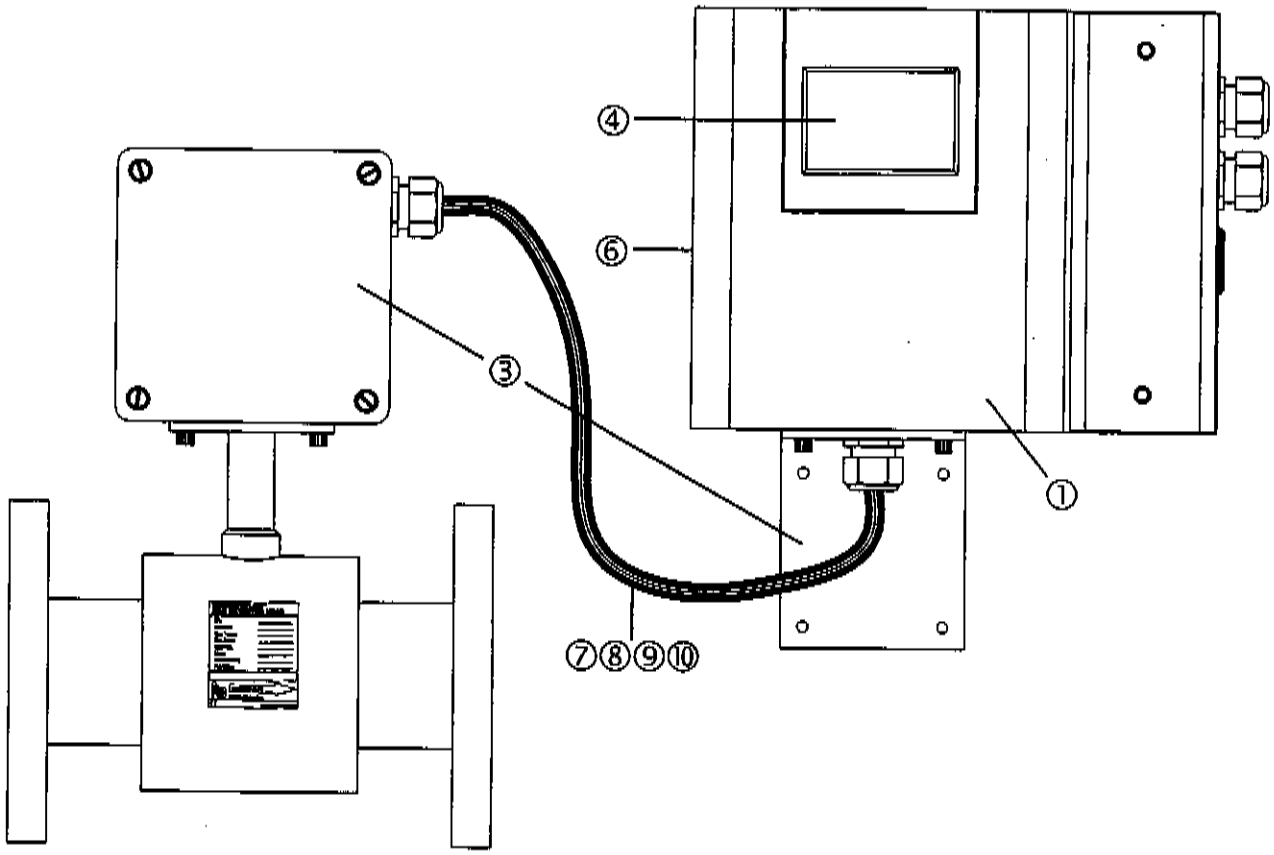
Please see our website at
www.badgermeter.com
for specific contacts.

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Spare Parts List

Magnetoflow® Mag Meter	Model Magnetoflow (3.1 Electronics)	Repair Parts



ITEM NO.	DESCRIPTION	PART NUMBER
1	Primo® Amplifier Assembly Complete	63384-036
3	Remote Mounting Kit less Cable (includes wall mount bracket)	63384-035
4	Primo LCD Display	63384-019
5	Primo Mother Board Assembly (Not Pictured)	63384-037
6	Primo Housing less Display and Board Assembly	63384-021
7	Cable - 15 feet	64574-002
8	Cable - 30 feet	64574-003
9	Cable - 50 feet	64574-004
10	Cable - 100 feet	64574-005

IRP-206-01

12-02

Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding bid obligation exists.

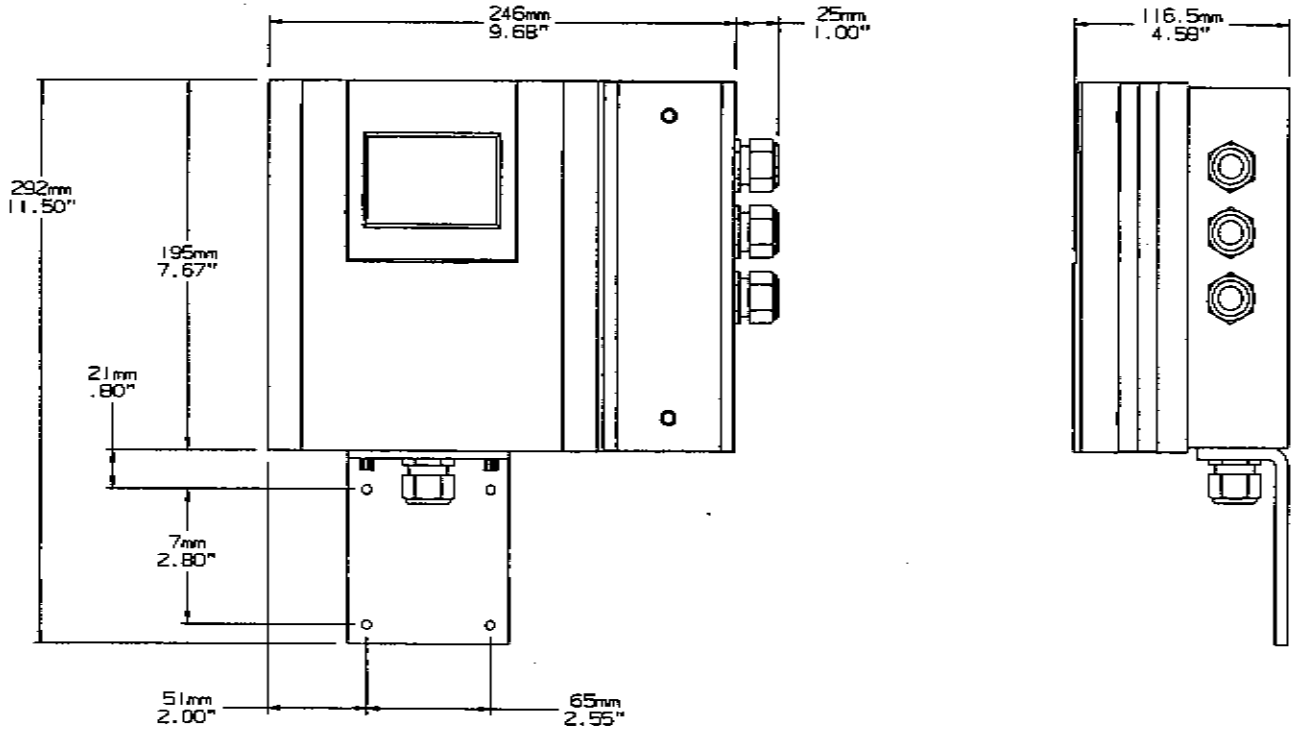
Please see our website at
www.badgermeter.com
for specific contacts.

BadgerMeter,Inc.
P.O. Box 245036, Milwaukee, WI 53224-9536
Telephone: (414) 355-0400 / (877) 243-1010
Fax: (414) 355-7499 / (866) 613-9305
www.badgermeter.com

Factory Test Data

CHG in ocess

S-885
DRAWING NO.



CERTIFIED

Signature 6/4/03 Date

CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED
ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER SHOWN ON THIS DRAWING ARE EXCLUSIVE PROPERTY OF BADGER METER INC.	TOL. ON THREE PLACE DECIMAL DIMENSIONS ± .005
	TOL. ON TWO PLACE DECIMAL DIMENSIONS ± .010
	TOL. ON ANGULAR DIMENSIONS ±
	MICRO-FINISH
	DEBURR: SEP. MFG 2003

ISSUE	CHANGE	BY	DATE
A		JK	05/27/98

BADGER METER, INC.

MAG MTR REM. TYPE PRIMO MODEL AMPLIFIER SIZE

INSTALLATION DIMENSIONS

PART NAME

MATERIAL:

PART NO.	REV.
DRAWN JK 05/27/98	
CHECKED RF 05/27/98	
APPROVED	
SCALE: NONE	
SHEET 1 OF 1	
S-885 DRAWING NO.	A ISSUE

CHG in ess

S-884 DRAWING NO.

METER SIZE		A		B		C		D		EST. WEIGHT WITH PRIMO	
inch	mm	Inch	mm	Inch	mm	Inch	mm	inch	mm	Lbs.	Kg.
1/4	6	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
5/16	8	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
3/8	10	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
1/2	15	6.7	170	14.0	356	3.5	89	11.4	288	12	5.5
3/4	20	6.7	170	14.2	361	3.9	99	11.5	293	15	6.5
1	25	8.9	225	14.4	366	4.3	108	11.7	298	20	9.0
1 1/4	32	8.9	225	15.2	386	4.6	117	12.5	318	22	10.0
1 1/2	40	8.9	225	15.4	390	5.0	127	12.7	322	23	10.5
2	50	8.9	225	15.9	403	6.0	152	13.2	335	28	12.5
2 1/2	65	11.0	279	17.1	434	7.0	178	14.4	366	54	24.5
3	80	11.0	279	17.3	440	7.5	191	14.7	372	56	25.5
4	100	11.0	279	18.4	466	9.0	229	15.7	398	58	26.5
5	125	15.8	400	19.6	498	10.0	254	16.9	430	101	46.0
6	150	15.8	400	20.6	524	11.0	279	17.9	456	110	50.0
8	200	15.8	400	22.5	572	13.5	343	20.4	518	110	50.0
10	250	19.7	500	26.8	681	16.0	406	24.1	613	180	82.0
12	300	19.7	500	28.9	734	19.0	483	26.2	666	209	95.0
14	350	23.6	600	30.8	782	21.0	533	28.2	716	260	118
16	400	23.6	600	33.7	856	23.5	597	31.0	788	308	140
20	500	23.6	600	38.2	969	27.5	699	35.5	901	495	225
24	600	23.6	600	42.2	1071	32.0	813	39.5	1003	554	252
28	700	23.6	600	46.2	1173	36.5	927	44.0	1118	650	295
32	800	31.5	800	52.2	1325	41.4	1015	49.5	1257	770	350
36	900	31.5	800	55.3	1405	46.0	1168	54.1	1374	850	386
40	1000	31.5	800	60.0	1525	50.2	1230	57.4	1457	924	420
48	1200	39.4	1000	69.9	1775	59.4	1495	67.2	1707	1210	550
56	1400	39.4	1000	78.5	1995	68.4	1675	75.9	1927	1364	620

UNLESS OTHERWISE SPECIFIED
TOL. ON THREE PLACE DECIMAL DIMENSIONS ± .005
TOL. ON TWO PLACE DECIMAL DIMENSIONS ± .010
TOL. ON ANGULAR DIMENSIONS ±
MICRO-FINISH
DEBURR: PER. MFG. STD.

ISSUE	CHANGE	BY	DATE
A		JK	05/27/98

BADGER METER, INC.

MAG MTR REM FLANGED 1/4" - 56"
TYPE MODEL SIZE

INSTALLATION DIMENSIONS

PART NAME

MATERIAL:

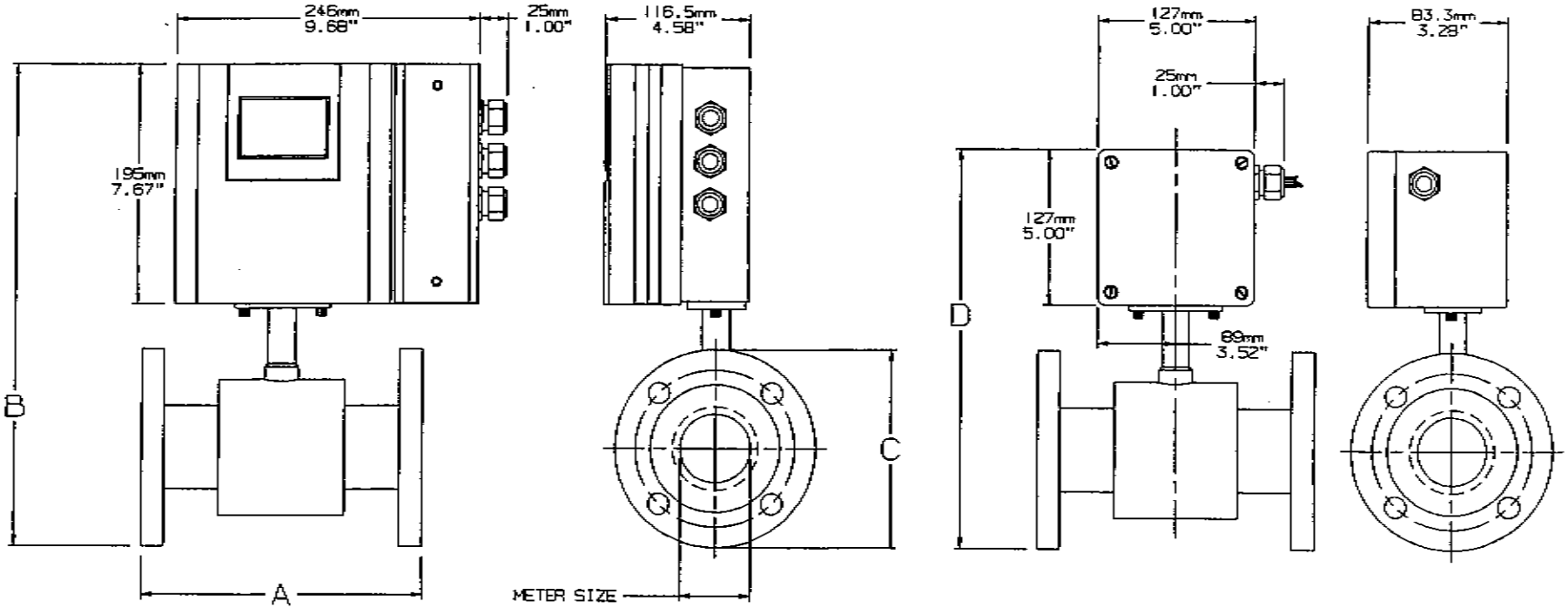
DRAWN JK 05/27/98
CHECKED RF 05/27/98
APPROVED
SCALE: NONE
SHEET 2 OF 2

S-884 DRAWING NO. A ISSUE

6/11/2003

CHG in cess

S-884
DRAWING NO.



CERTIFIED

Signature 6/11/03 Date

CONFIDENTIAL	UNLESS OTHERWISE SPECIFIED
ALL PROPRIETARY RIGHTS IN THE SUBJECT MATTER SHOWN ON THIS DRAWING ARE EXCLUSIVE PROPERTY OF BADGER METER INC.	TOL. ON THREE PLACE DECIMAL DIMENSIONS ± .005
	TOL. ON TWO PLACE DECIMAL DIMENSIONS ± .010
	TOL. ON ANGULAR DIMENSIONS ±
	MICRO-FINISH
	DEBURR: PER MFG STD

ISSUE	CHANGE	BY	DATE
A		JK	05/27/98

BADGER METER, INC.

TYPE MAG MTR REM MODEL FLANGED SIZE 1/4" - 56"

PART NAME INSTALLATION DIMENSIONS

MATERIAL:

DRAWN	JK 05/27/98
CHECKED	RF 05/27/98
APPROVED	
SCALE:	NONE
SHEET	1 OF 2
S-884 DRAWING NO.	A ISSUE

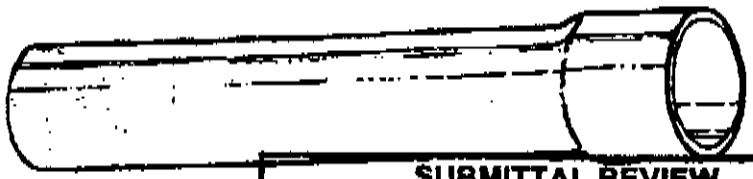
Catalog Cutsheets for all Basic Materials

(ATTN. JEFF)

PWPipe

PVC Rigid Electrical Conduit

Schedule 40 Conduit



UL LISTED

Conforms to UL 651 and NEMA TC 2

1. Conduit conforms to UL 651 including 90° C rating and sunlight resistance criteria.
2. All conduit is produced with integral solvent-weld bells. Plain-end conduit may be available.
3. Conduit is produced in 10-foot lengths. 20-foot lengths may be available.
4. Conduit color is gray, except where noted.

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimension, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X	No Exceptions Taken
	Furnish as Corrected
	Amend and resubmit
	Rejected

Date 8/25/03 Department Engr.

By: [signature]

Item Number	Trade Size	Average Outside Diameter (inches)	Approximate Inside Diameter (inches)	Minimum Wall Thickness (inches)	Approximate Weight (lbs/100')
4600500103	½	0.084	0.60	0.109	16
4600750103	¾	1.050	0.80	0.113	22
4601000103	1	1.315	1.03	0.133	32
4601250103	1¼	1.660	1.36	0.140	46
4601500103	1½	1.900	1.59	0.145	54
4602000103	2	2.375	2.04	0.154	73
4602500103	2½	2.875	2.44	0.203	120
4603000103	3	3.500	3.03	0.216	170
4603500103	3½	4.000	3.51	0.226	200
4604000103	4	4.500	3.99	0.237	230
4605000103	5	5.563	5.01	0.258	320
4606000103	6	6.625	6.02	0.280	410

P.O. Box 10049, Eugene, Oregon 97440-2049 (800) 347-0200 (541) 343-0200 Fax (541) 686-9253

Wire Meggered Test

MOGENSEN ELECTRIC INC.

INDUSTRIAL • COMMERCIAL

P.O. Box 308 • Moab, Utah 84532
Telephone/Fax: 435.259.6386

10/24/2003

TO: Palisade Contractors, Inc.
Attn: Mark

RE: Stoller/ Atlas Mill Site
Electrical test results.

Testing done by Jeff Mogensen and was found to be in good order.

480 Volt single phase line: 7/31/03 – Test was done for continuity and grounding with ohm meter. Continuity was found to be in order for both phases and ground.
Megger test was done at 500 volt and 1000 volt. No insulation leakage was detected.

480 volt three phase line: 8/5/03 – Continuity test was done on all three phases and ground. Continuity was found to be in order on all four wires.
Megger test was done at 500 volt and 1000 volt. No insulation leakage was detected.

Jeff Mogensen

President

Manufacturer's Catalog Information

Wellfield 1/1
Dist. panel

Ckt	Left	Right	Ckt
1, 3	BAB2100H	BAB2020	2, 4
5, 7	BAB2020	BAB2020	6, 8
9, 11	BAB2020	BAB2020	10, 12
13, 15	BAB2020	BAB2020	14, 16
17, 19	BAB2020	BAB2020	18, 20
21, 23	BAB2020	BAB1020	22
		BAB1020	24
25	BAB1020	BAB1020	26
27	PROVBAB1	PROVBAB1	28
29	PROVBAB1	PROVBAB1	30
31	PROVBAB1	PROVBAB1	32
33	blank	blank	34
35	blank	blank	36
37	blank	blank	38
39	blank	blank	40
41	blank	blank	42

General Information

Service Voltage: 120/240 1Ph 3W
Bus Bar: 100A-Al
Neutral: 100A
S.C. Rating: 10k A.I.C. Fully-Rated
Enclosure: NEMA3R

	Main:	Outgoing:
Catalog #	BAB2100H	(None)
Type:	Breaker	
Location:	Top	
Trip:	100	
Terminal:	Mechanical (Al)	
Qty/Range:	(1) #8-1/0 (Cu/Al)	

Box Catalog#: LW?Q2036

Box

		Gutter	
Height: 36"/914.4mm		Top:	[illegible]
Width: 20"/508.0mm		Bottom:	5.5"/139.7mm
Depth: 6"/152.4mm		Left:	5.0"/127.0mm
		Right:	5.0"/127.0mm

Ground Bar: Bolted

Mastic Nameplate: (1) (2) (3)

NEC Lighting & Appliance, UL CTL — Standard Panel

Plant Information — ***Non-Interchangeable Main Device***

Main Chassis: 2C11810G01
Bus Assembly: 1C96627G01
Neutral: 1C96646G01
Ground Bar: 5158C05G02
Panel Packing: 1C96637G02
UL CTL: 1C96624G01

Bus Cat: 1C968-7H31
Assembly DFC: 1C966-3G02
Nameplate: 24A[illegible]

Modifications

Qty | Ref # | Catalog # | Description

Branch Devices

Qty	Poles	Trip	Frame	Amps	KAIC
4	1	20	BAB	100	10
10	[illegible]	20	BAB	100	10
6	1	0	PROVBAB	[illegible]	[illegible]

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department EN6
By [signature]

Notes

PREPARED BY: J107 — DATE: 06/30/03
APPROVED BY: — DATE:

Cutler-Hammer — Sumter, SC

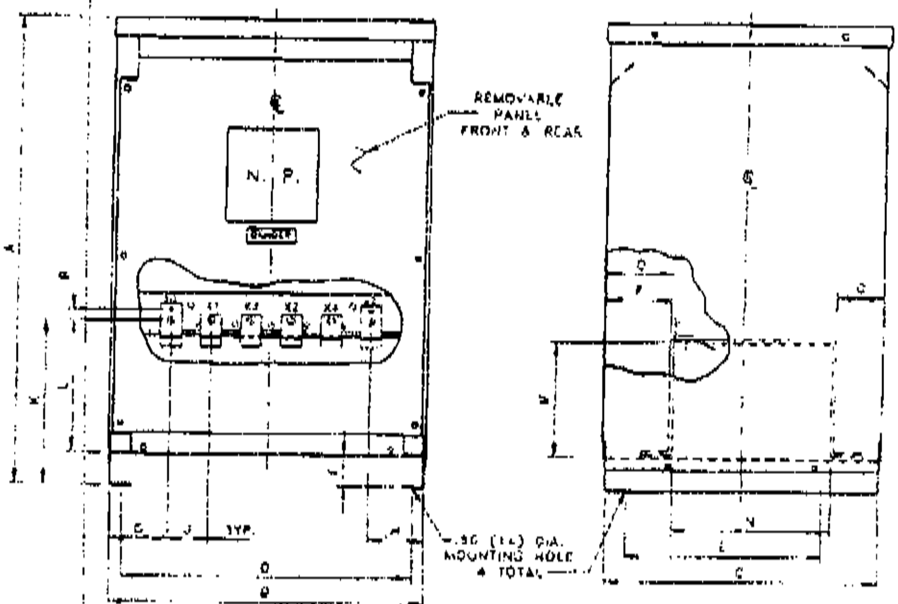
JOB NAME: AYLAS
DESIGNATION:
VERSION: 4.3
TYPE: Pow-R-Line1a
DRAWING TYPE: Customer Appr.
REG-ALT NUMBER: J10706302301-0000
REVISION:
DWG SIZE: A
G.O.
ITEM
SHEET 1 OF 1

37.5 KVA X-FORMER @ wellfield

1/2

REF DWG NO 42-4464

NOTES:
1. ALL UNITS ARE DESIGNED IN ACCORDANCE WITH APPLICABLE NEMA, UL, ANSI AND IEEE STANDARDS.
2. DRY-TYPE VENTILATED, CLASS AA, NEMA TYPE 2 ENCLOSURE.
3. FOR NEMA 3R OUTDOOR APPLICATION, USE WEATHERSHIELD # WS-11
4. TRANSFORMERS ARE FLOOR MOUNTED.
5. 220°C CLASS INSULATION SYSTEM.
6. PAINT COLOR IS ANSI #61.
7. ALUMINUM UNITS HAVE ALUMINUM WINDINGS AND TERMINATIONS. COPPER UNITS HAVE COPPER WINDINGS AND TERMINATIONS.



DIMENSIONS IN inches (mm)

FRAME	KVA	APPROX NET WT. LBS(KG) ALUMINUM	COPPER	A	B	C	D	E	F
817	25.0/37.5	306(139)	343(156)	37.53(953)	22.59(574)	19.50(495)	20.91(531)	16.00(406)	2.53(64)
				G	H	J	K	L	M
				4.13(105)	3.91(99)	2.88(73)	13.47(342)	10.85(276)	9.27(235)
				N	O	P	Q	R	
				11.37(289)	4.88(124)	4.63(117)	3.28(83)	.88(22)	

THIS DIMENSION DRAWING IS FOR REFERENCE ONLY. IT IS NOT TO BE REGARDED AS INDICATING THE EXACT DETAILS OF CONSTRUCTION.

5/02

THE INFORMATION ON THIS DOCUMENT IS CREATED BY CUTLER-HAMMER. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

DEG 12/01/00 | APPD FFR 12/01/00

Cutler-Hammer

TITLE DRY TYPE TRANSFORMER OUTLINE

TYPE TRANSFORMER

PRODUCT CODE TRANSFORMER | REVISION 03 | DWG SIZE A | FR817

THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON'S CUTLER-HAMMER BUSINESS. IT IS DISCLOSED IN CONFIDENCE AND IT IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

LEGACY NUMBER SL5106265302-0000

PREPARED BY TAYLOCB | DATE 06/26/03
APPROVED BY | DATE
VERSION 4.4.0
REVISION | DWG SIZE A

Eaton's Cutler-Hammer Business

JOB NAME
DESIGNATION
TYPE T20P11S37
G.O.

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Customer Approval

DRAWING TYPE
ITEM
SHEET 1 OF 2

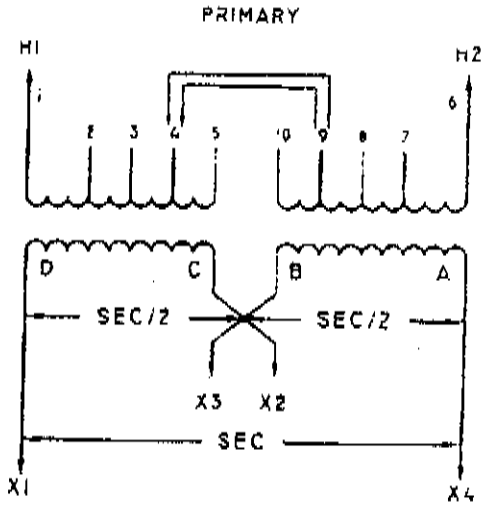
Date 7/9/03 Department

By [signature]

FIGURE 3XA

	VOLTS	CONNECT	LINE
PRI		USE 2 CABLES	HI-H2
	504	5 TO 10	
	492	5 TO 9	
	480	4 TO 9	
	468	4 TO 8	
	456	3 TO 8	
	444	3 TO 7	
	432	2 TO 7	
		USE 1 CABLE:	
	252	5 TO H2 & 10 TO HI	
	240	4 TO H2 & 9 TO HI	
	228	3 TO H2 & 8 TO HI	
	216	2 TO H2 & 7 TO HI	
SEC	240	X2 TO X3	X1-X4
	120	X1 TO X3 & X2 TO X4	
	* 120/240	X2 TO X3	X1-X3-X4

* THREE WIRE OPERATION



PREPARED BY: TAYLOCB	DATE: 06/26/03	Eaton's Cutler-Hammer Business	Pittsburgh, PA
APPROVED BY:	DATE:	JOB NAME: XFMR for CED	
		DESIGNATION:	
VERSION: 4.4.0		TYPE: T20P11S37	DRAWING TYPE: Customer Approval
REVISION:	DWG SIZE: A	G.O.	ITEM: SHEET 2 OF 2

XEC-ALT NUMBER: SLE10625302-0000

3EPT

Enclosures

Main breakers at each site 1/2

Type 1 General Purpose

- Surface or flush mounting
- 15 – 1200 ampere range
- 600V AC, 500V DC

Type 1 enclosed breakers are designed for use in commercial buildings, apartment buildings and other areas where a general purpose enclosure is applicable. The breaker is front operable and is capable of being padlocked in either the ON or OFF position. Ratings through 1200 amperes are listed with Underwriters Laboratories as approved for service entrance application. Both surface and flush mounted enclosures are available.

Type 3R Rainproof Surface Mounting

- Interchangeable hubs (through 400 amperes)
- 15 – 1200 ampere range
- 600V AC, 500V DC

This general purpose outdoor service center employs a circuit breaker inside a weatherproof sheet steel breaker enclosure to serve as a main disconnect and protective device for feeder circuits. Ratings through 1200 amperes are listed by Underwriters Laboratories as suitable for service entrance application.

Type 12 Dustproof Surface Mounting

- No knockouts or other openings
- 15 – 1200 ampere range
- 600V AC, 500V DC

The Type 12 enclosure is designed in line with specifications for special industry application where unusually severe conditions involving oil, coolant, dust and other foreign materials exist in the operating atmosphere. The handle padlocks in the OFF position and the cover is interlocked with the handle mechanism to prevent opening the cover with the circuit breaker in the ON position. Ratings through 1200 amperes are listed by Underwriters Laboratories as suitable for service entrance application.

12

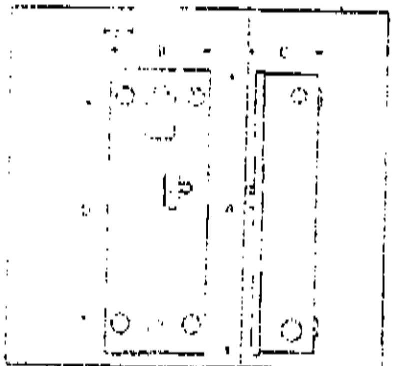


Figure 12-27. Type 1 Surface Mounted

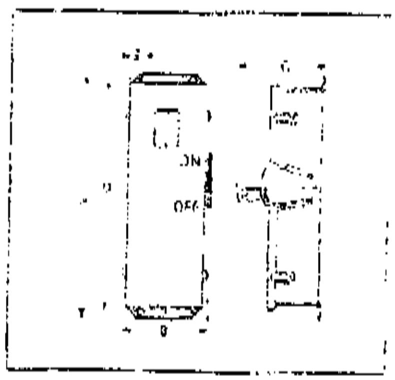


Figure 12-28. Type 3R Rainproof

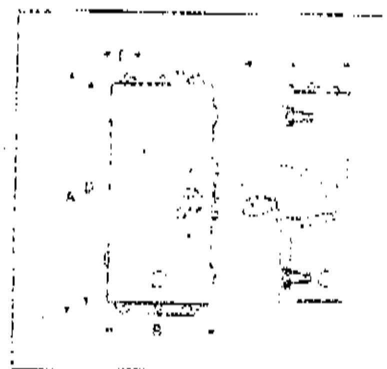


Figure 12-29. Type 12, 12K Dustproof

Table 12-267. Enclosure Selection Data

Breaker Frame Amperes	Enclosure Type Class	Dimensions A Inches	A mm	B Inches	B mm	C Inches	C mm	D Inches	D mm	E Inches	E mm	App. Wt. Lbs.	Conduit Sizes, Inches	Catalog Number	Price U.S. $
FC 15 – 225	Type 1	23.26	591	8.41	214	6.28	160	18.76	476	1.20	31	16	.25, .50, .75, 1, 1.25, 1.50, 2, 2.50	SFDN225	18[illegible]
	Type 3R	25.66	652	8.84	225	9.31	237	24.28	617	1.70	43	19	.25, .50, .75, 1, 1.25, 1.50, 2, 2.60	RFDN225	46[illegible]
	Type 12	25.66	652	8.84	220	9.31	239	24.28	618	1.70	43	19		JFDN225	252
JG 175 – 250	Type 1	34.70	[illegible]	10.92	277	7.20	183	30.00	762	1.84	46	31	.25, .50, 2, 2.50, 3	SJDN250	186.
	Type 3R	37.50	397	11.56	294	10.22	260	35.77	909	1.94	49	40	.25, .50, 2, 2.50, 3	RJDN250	390
	Type 12	37.53	953	11.56	294	10.22	260	35.77	909	1.94	49	37		JJDN250	[illegible]
KG 300 – 400	Type 1	38.81	986	11.06	281	10.94	278	34.00	869	2.28	58	53	.25, .50, .75, 1.50, 2, 2.50, 3, 3.50	SKDN400	265.
	Type 3R	41.88	397	11.75	298	14.06	357	39.90	1014	1.87	50	60	.25, .50, .75, 2.50, 3, 3.50	RKDN400	[illegible]
	Type 12	41.88	997	11.75	298	14.06	357	39.90	1015	1.97	[illegible]	53		JKDN400	[illegible]
LG 450 – 600	Type 1	45.89	1166	14.31	[illegible]	12.36	314	46.56	1183	1.91	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Type 3R	48.31	1227	14.91	[illegible]	15.50	394	46.56	1183	1.92	[illegible]	[illegible]	[illegible]	RLDN600	[illegible]
	Type 12	48.31	1227	14.91	[illegible]	15.50	394	46.56	1183	1.92	[illegible]	[illegible]		JLDN600	[illegible]
NG 700 – 1200	Type 1	61.22	1555	21.44	54[illegible]	15.41	391	61.84	1571	1.97	[illegible]	[illegible]	[illegible]	SNDN1200	[illegible]
	Type 3R	63.59	1616	22.00	559	17.63	448	61.84	1571	1.97	[illegible]	[illegible]	[illegible]	RNDN1200	[illegible]
	Type 12	63.59	1615	22.00	559	17.63	448	61.84	1571	1.97	[illegible]	[illegible]		JNDN1200	[illegible]

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and to determine conformity to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X No Exceptions Taken
Furnish as Corrected
Amend and Resubmit
Rejected

Date 7/9/03 Department
By

Product Selection

Table 12-33. Types EC, EDH, and EDC Thermal-Magnetic Circuit Breakers with Non-interchangeable Trip Units Suitable for Reverse Feed

Maximum Continuous Ampere Rating @ 40°C	240V AC Maximum, 125V DC (Includes Terminals on Load End Only)											
	65 kAIC @ 240V AC				100 kAIC @ 240V AC				200 kAIC @ 240V AC			
	Type ED				Type EDH				Type EDC Current Limiting			
	2-Pole		3-Pole		2-Pole		3-Pole		2-Pole		3-Pole	
	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
100	ED2100	357.	ED3100	885.	EDH2100	650.	EDH3100	1,280.	EDC2100	1,200.	EDC3100	1,655.
125	ED2125	357.	ED3125	885.	EDH2125	650.	EDH3125	1,280.	EDC2125	1,200.	EDC3125	1,655.
150	ED2150	357.	ED3150	885.	EDH2150	650.	EDH3150	1,280.	EDC2150	1,200.	EDC3150	1,655.
175	ED2175	357.	ED3175	885.	EDH2175	650.	EDH3175	1,280.	EDC2175	1,200.	EDC3175	1,655.
200	ED2200	357.	ED3200	885.	EDH2200	650.	EDH3200	1,280.	EDC2200	1,200.	EDC3200	1,655.
225	ED2225	357.	ED3225	885.	EDH2225	650.	EDH3225	1,290.	EDC2225	1,200.	EDC3225	1,655.

Note: Instruction Leaflet/FRED Number 29C101

Table 12-34. Type EHD Thermal-Magnetic Circuit Breakers with Non-interchangeable Trip Units

Maximum Continuous Ampere Rating @ 40°C	277V AC Maximum, 125V DC		480V AC Maximum, 250V DC			
	14 kAIC @ 277V AC		14 kAIC @ 480V AC			
	Type EHD (Includes Terminals on Load End Only)					
	1-Pole		2-Pole		3-Pole	
	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $	Catalog Number	Price U.S. $
10	EHD1010		EHD2010	387.	EHD3010	498.
15	EHD1015		EHD2015	387.	EHD3015	498.
20	EHD1020		EHD2020	387.	EHD3020	498.
25	EHD1025		EHD2025	387.	EHD3025	498.
30	EHD1030		EHD2030	387.	EHD3030	498.
35	EHD1035		EHD2035	387.	EHD3035	498.
40	EHD1040		EHD2040	387.	EHD3040	498.
45	EHD1045		EHD2045	387.	EHD3045	498.
50	EHD1050		EHD2050	387.	EHD3050	498.
60	EHD1060		EHD2060	387.	EHD3060	498.
70	EHD1070		EHD2070	505.	EHD3070	600.
80	EHD1080		EHD2080	505.	EHD3080	600.
90	EHD1090		EHD2090	505.	EHD3090	600.
100	EHD1100		EHD2100	505.	EHD3100	600.

- Not UL listed, 5 kAIC interrupting rating.
- UL listed for SWD applications, see NEC Article 240-83 (d).

Note: Instruction Leaflet/FRED Number 29C101

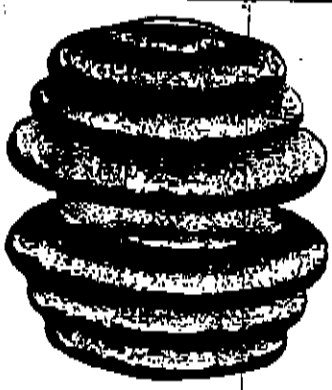
12

Industries
226 N. Patterson Street
Carey, Ohio 43316
419/396-7521

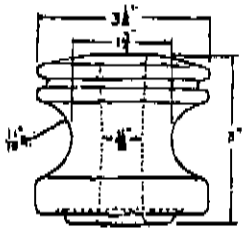
ATTN: JEFF ... "ATLAS SUBS"

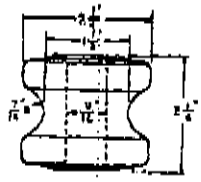
SPOOL AND GUY STRAIN INSULATORS

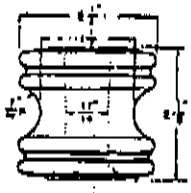
WET PROCESS PORCELAIN

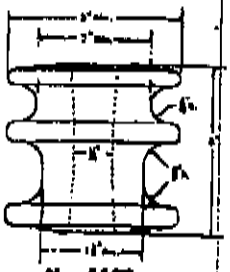

No. 5116

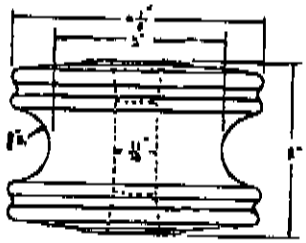

No. 5101

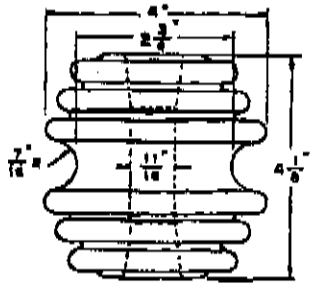

No. 5101

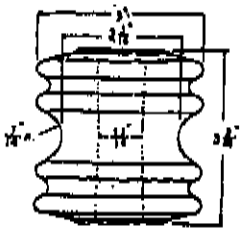

No. 5107


No. 5112


No. 5102


No. 5119

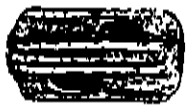
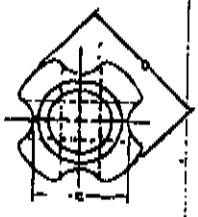
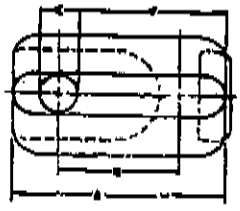
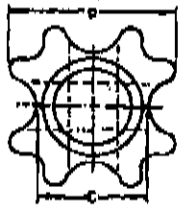
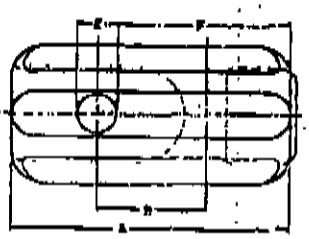

No. 5116


No. 5104

MECHANICAL AND ELECTRICAL CHARACTERISTICS

Catalog Number	ANSI Class	Ultimate Strength Lbs.	LOW-FREQUENCY FLASHOVER-KV Dry	Wet Vert.	Wet Horiz.	Approximate Net Weight Per 100 Pcs.	Standard Package Quantity
†5101	53-2	3000	25	12	15	120	50
5102	—	3000	20	10	12	110	50
5104	53-3	4000	25	12	15	135	50
†5107	—	1750	18	7	9	45	100
5112	53-1	2000	20	8	10	50	100
5116	53-5	6000	35	18	25	260	20
†5119	53-4	4500	25	12	15	252	25

Standard Glaze "Skyline" ANSI-70, Munsell 5 BG 7.0/0.4
†REA Accepted





Nos. 502-504-506


No. 708

Cat. No.	ANSI Class	Tensile Strength Pounds	Low Frequency Flashover KV Dry	Wet	Leakage Distance Inches	Maximum Cable Diameter Inches	DIMENSIONS IN INCHES A	B	C	D	E	F	Approx. Net Wt. Per 100 Pcs.	Standard Package Quantity
†502	54-1	10,000	25	12	1⅝	⅝	3⅛	1⅝	1⅜	2⅛	⅝	2⅝	112	50
†504	54-2	15,000	30	18	1⅞	⅛	4¼	2¼	2⅛	2⅞	⅞	2½	188	25
†506	54-3	20,000	35	18	2¼	⅝	5⅛	3⅛	2⅝	3⅜	1	3½	296	25
708	54-4	20,000	40	23	3	⅞	6¾	2⅝	2⅝	3½	1	4⅛	475	20

Standard Glaze "Skyline" ANSI-70, Munsell 5 BG 7.0/0.4
†REA Accepted

BUST-CLEAN™ Expanding Anchor

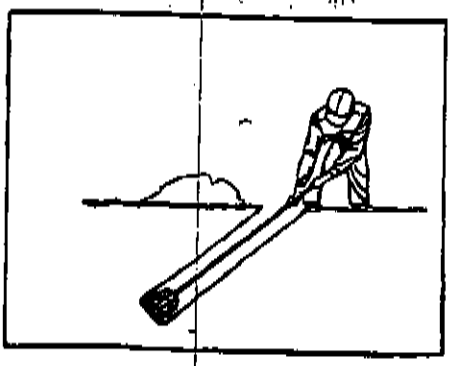
U.S. Patent No. 5,775,848

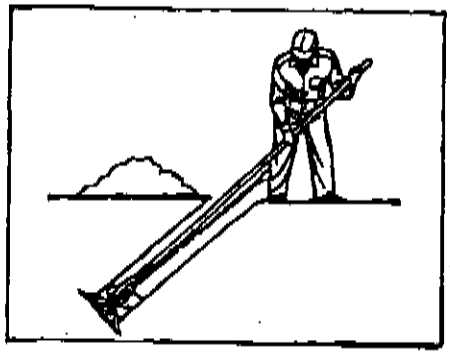
MORE HOLDING CAPACITY FOR LESS

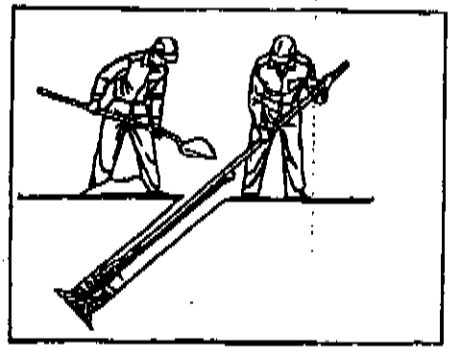
Four different sizes are available with holding capacity as high as 40,000 pounds.

Chance 8-Way Expanding Anchors expand to take full advantage of the available area. All eight blades wedge into undisturbed earth . . . there is no wasted space between blades.

This anchor should be installed in relatively dry and solid soils. The effectiveness of the anchor is dependent upon the thoroughness of backfill tamping.







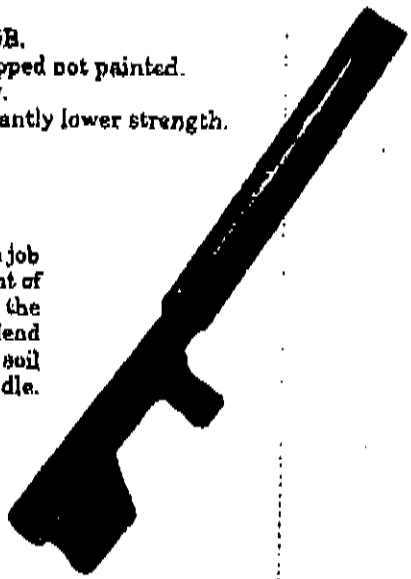
APPLICATION AND ORDERING INFORMATION

Catalog Number	Anchor Hole Size	Area Sq. In.	Rod Size (Order Separately)	Std. Pkg./ Pallet	8-Way Anchor Holding Strengths - (lbs.) vs Chance Soil Class				
					Class 3	Class 4	Class 5	Class 6	Class 7
6870*	6"	70	⅝"	12/288	16000	14000	11000	8500	5000
88135*	8"	135	⅝" or ¾"	6/150	26500+	22000+	18000+	15000	10000
1082	10"	200	1"	4/48	31000	26500	21000	16500	12000
1082-¾	10"	200	¾"	4/48	31000+	26500+	21000	16500	12000
1283	12"	300	1¼"	2/26	40000	34000	26500	21500	16000
1283-1	12"	300	1"	2/26	40000+	34000	26500	21500	16000

+Ultimate strength of rod may control. (See page 4-19 for rod ratings and selection.)
Add suffix "G" for galvanized. Example: 88135G.
Add suffix "B" for plastic wrapped (88135 and 6870 only) example 88135B.
*RUS Accepted, painted version only. Standard anchors are plastic wrapped not painted.
Note: Ultimate strength ratings apply to properly installed anchors only.
Failure to install within 10° of alignment with the guy load may significantly lower strength.

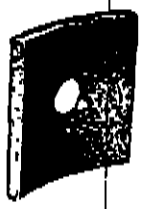
EXPANDING & TAMPING BAR

The Improved Chance fiberglass handle Expanding and Tamping Bar simplifies the job of expanding anchors. The curved Tamper and Expander Head distributes the weight of the bar evenly around the anchor rod to reduce handle vibration. The hook of the Expanding and Tamping Bar wraps around the anchor rod to keep the Expanding Head from slipping off the anchor top plate. This tool is also effectively used for tamping in soil above the installed anchor. The base casting is attached directly to the Epoxiglas handle.

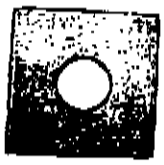


Cat. No.	Description	Length	Weight
C302-0008	Expanding & Tamping Bar	10'	22 lbs.
C302-0004	Expanding & Tamping Bar	12'	24 lbs.

To order fiberglass replacement handles or expander head, see page 4A-11.



Curved



Square

Round

WASHERS

Galvanized Curved Washers

Catalog No	Dimensions in Inches			Approx. Ship Wt. Lbs. Per 100 Pcs.
	Washer Size	Hole Dia.	Bolt Dia.	
*6809½	4 x 4 x ¼	15/16	⅞	120
*6810½	2¼ x 2¼ x 3/16	11/16	⅝	31
6822	2½ x 2½ x 3/16	11/16	⅝	38
*6822½	3 x 3 x ¼	13/16	¾	66
6823	3 x 3 x ¼	⅞	¾	62
*6823½	3 x 3 x ⅛	13/16	⅝	62
6826	3⅛ x 3¼ x ¼	13/16	¾	76

Square Washers

*6811	2 x 2 x ⅛	9/16	⅜	13
*6812	2 x 2 x ¼	11/16	⅝	12
*6813	2¼ x 2¼ x 3/16	11/16	⅝	24
†*6814	2½ x 2½ x 3/16	11/16	¾	23
6816	3 x 3 x 3/16	13/16	¾	51
†*6817	3 x 3 x ¼	13/16	¾	64
†6818	4 x 4 x 3/16	13/16	¾	87
*6818½	4 x 4 x ¼	⅞	¾	120
*6819	4 x 4 x ¼	15/16	⅞	116
†6819½	4 x 4 x ½	15/16	¾	236
6820	4 x 4 x ½	1⅛	1	228

Round Washers

*6801	1 O.D. x 14 Ga.	7/16	⅜	1.64
†*6802	1¼ O.D. x 14 Ga.	9/16	⅝	2.84
†*6803	1⅜ O.D. x 12 Ga.	9/16	½	4.50
†*6805	1¾ O.D. x 10 Ga.	11/16	⅝	8.50
*6806	2 O.D. x 9 Ga.	13/16	¾	11.80

*NEMA Standard
†RUS listed

Spring Clip

Spring Lock

Double Coil Spring

Spring Clip Washers

Catalog No	Stock	Dimensions in Inches		Approx. Ship Wt. Lbs. Per 100 Pcs.
		Hole Size	Bolt Size	
3539	3/32" x 1"	9/16	⅜	22
T3540	⅛" x 1¾"	11/16	⅝	93
T3541	⅛ x 1¾"	13/16	¾	91
C205-0092	¼" x 1½"	11/16	⅝	62

Spring Lock Washers

4035	1/64 x 1/4"	7/16	⅛	1.6
4036	13/64 x 5/16	11/16	⅜	2.4
4037	¼ x 3/16	13/16	¾	4.8

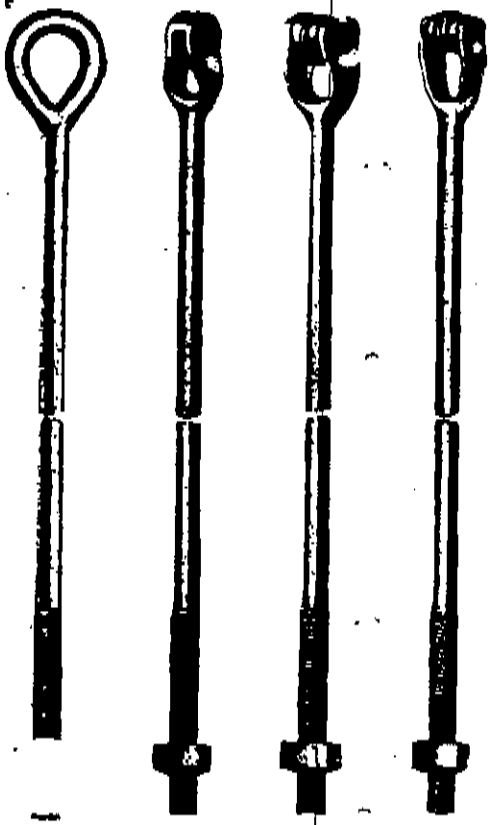
Double Coil Spring Lockwasher

C205-0185	5/32" x 1"	7/16	⅛	4
C205-0186	3/16" x 1¾"	11/16	⅝	8.6
C205-0187	7/32" x 1⅜"	13/16	¾	10.40
C205-0188	7/32" x ½"	7/16	⅛	1.50

†RUS listed

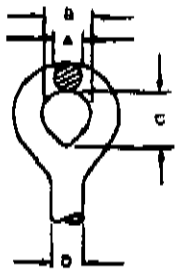
CHANCE

RODS, ANCHOR, GALVANIZED



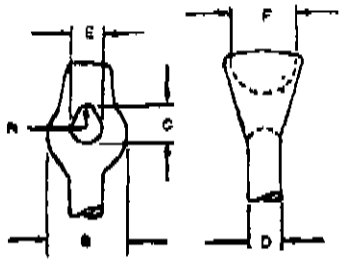
Available for one, two, or three guys for use with expanding, cone, and cross-plate anchors. The Thimbleye®, Twineye® and Tripleye® distribute pulling stresses uniformly over individual strands of guy wire and keep the guy wire from spreading, kinking, or bending. The drop-forged eye of each anchor rod is stronger than the rod itself. Rod length and diameter are stamped below the eye of each rod eye. Each rod is threaded 3½" minimum length.

Nuts included. To order extras, see Page 5-36.



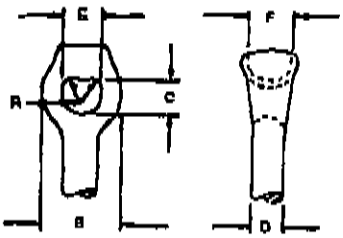
OVALEYE

D	A	B	C
⅝"	5/16"	1 1/8"	2"
1"	⅜"	1 1/2"	2"



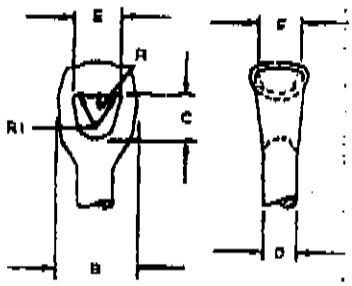
THIMBLEYE®

D	*R	B	C	E	F
½"	5/16"	1¼"	5/16"	½"	1 1/2"
⅝"	¼"	1 1/2"	11/16"	5/16"	1 3/8"
¾"	5/32"	1 5/8"	13/16"	11/16"	1 1/2"
1"	13/32"	2 1/16"	1 1/8"	13/16"	1 5/8"



TWINEYE®

D	*R	B	C	E	F
⅝"	5/32"	1 3/4"	7/8"	15/16	1 1/2"
¾"	¼"	2"	1"	1 1/16"	1 3/8"
1"	5/16"	2 5/8"	1 5/16	1 5/16	1 1/2"
1 1/4"	⅜"	2 15/16"	1 1/4"	1 5/16"	1 5/8"



TRIPLEYE®

D	*R	*R1	B	C	E	F
¾"	¼"	5/32"	2 1/2"	1 11/16"	1 3/8"	1 1/2"
1"	¼"	5/32"	2 5/8"	1 11/16"	1 5/8"	1 1/2"
1 1/4"	¼"	5/16"	2 3/4"	1 11/16"	1 15/16"	1 5/8"

TENSILE STRENGTH

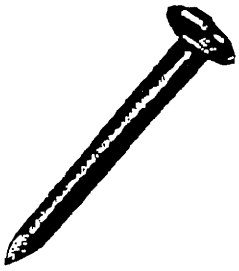
ROD"	STRENGTH LBS.
½	16,000
⅝	16,000
¾	23,000
1	36,000
1¼	56,000

*(2 x R or 2 x R1) + maximum-diameter guy strand.

Catalog No.				Approx. Ship Wt., Lbs. Per 100 Pieces				
Thimbleye	Twineye	Tripleye	Ovaleye	Size	Thimbleye	Twineye	Tripleye	Ovaleye
6305	—	—	—	½ x 6'	379	—	—	—
6306	—	—	—	½ x 8'	450	—	—	—
6307	—	—	—	½ x 7'	520	—	—	—
6315	—	—	—	⅝" x 6'	574	—	—	—
†*5316	5346	—	—	⅝" x 5'	650	680	—	—
†*6317	†*5347	—	6417	⅝" x 7'	760	780	—	760
†*6318	†*5348	—	—	⅝" x 8'	876	890	—	—
*6326	*6356	—	—	¾" x 6'	980	1012	1162	—
*6327	*6357	7557	—	¾" x 7'	1160	1120	1280	—
†*5328	†*6358	7058	—	¾" x 8'	1216	1300	1433	—
—	†*6359	7559	—	¾" x 9'	—	1400	—	—
—	†6360	—	—	¾" x 10'	—	1660	2280	—
*5338	*6368	7568	—	1" x 8'	2150	2160	—	—
—	†6369	—	—	1" x 9'	—	2450	2670	—
340	†*6370	*7670	6440	1" x 10'	2655	2700	—	2700
—	—	C200-6026	—	1¼ x 8'	—	—	3500	—
—	15129	7574	—	1¼ x 10'	—	4290	4290	—

*N.E.M.A. Standard †RUS Listed

NAILS, POLE DATING



Used to indicate the year in which poles are set. Heads are 5/8" diameter. Hot dip galvanized. Year determines catalog number.

Catalog No.	For Year	Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
C205-1997	1997	2½	5.3
C205-1998	1998	2½	5.3
C205-1999	1999	2½	5.3
C205-2000	2000	2½	5.3
C205-2001	2001	2½	5.3
C205-2002	2002	2½	5.3

NUTS

Made to give tight connections. Galvanized.

MF

Curved Lock Nuts

Catalog No.	Bolt Size, Inches	Wt. Lbs. Per 100 Pcs.
†3510	5/8	1.25
†3511	¾	2.6
†3512	7/8	4.44

Curved Lock Nuts

Catalog No.	Bolt Size, Inches	Wt. Lbs. Per 100 Pcs.
†3513	1	6
†3614	7/8	8.5

Palnut Lock Nuts

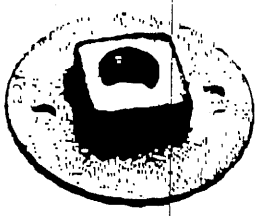
Catalog No.	Dimensions in Inches			Approx. Ship Wt. Lbs. Per 100 Pcs.
	Bolt Size	Width	Height	
3530	5/8	5/8	.160	.39
3531	¾	13/16	.190	.92
3532	5/8	1	.224	1.34
3533	1	1 1/16	.246	1.73

No. 3530

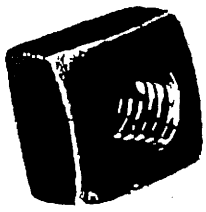
No. 3510

Washer Nuts

Catalog No.	Dimensions in Inches			Approx. Ship Wt. Lbs. Per 100 Pcs.
	Bolt Size	Washer Dia.	Sq. Size	
*3194	5/8	2½	15/16	38



No. 3194



55083P

For Bolts
Regular Square Nuts

Catalog No.	Bolt Size, Inches	Threads Per Inch	Wt. Lbs. Per 100 Pcs.
*8600M	5/8	16	2.6
*55083P	¾	13	8
*55084P	7/8	11	10.4
*55085P	1	10	14.4
*56538P	1 1/8	9	30
*56073P	1 1/4	8	50

For Rods
Heavy Square Nuts

Catalog No.	Rod Size, Inches	Wt. Lbs. Per 100 Pcs.
*55058P	½	12.5
*55006P	5/8	12.8
*55312P	¾	22
*55320P	1	50
*56001P	1 1/4	100

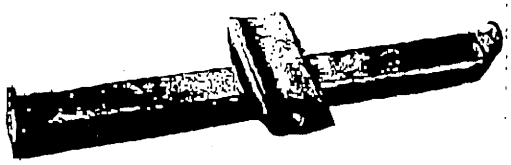
† RUS listed
*ANSI B18.2.2

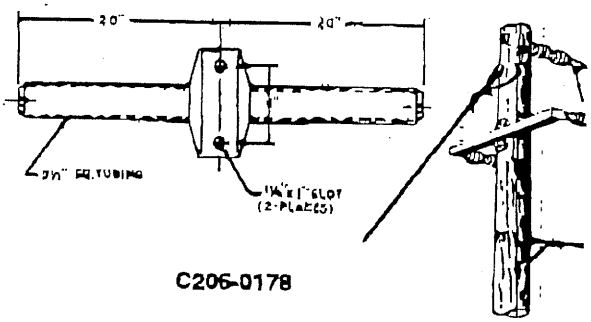
CROSSARM, STEEL DEADEND

Withstands high cantilever loading and provides extra strength for deadending, reducing conductor size or supporting slack spans. Both single and double deadends will accommodate a crossarm pin shank of either 3/4" or 5/8" diameter for jumper applications.

Catalog No.	Application	Length	Each Phase Rating	Pieces Per Package	Wt. Per 100 Pieces
C206-0178	Single	40"	*5500 lbs.	1	3700 lbs.
†C206-0179	Double	40"	*5500 lbs.	1	3600 lbs.
†C206-0211	Double	48"	*8000 lbs.	1	4400 lbs.

†RUS listed
*Balanced Load





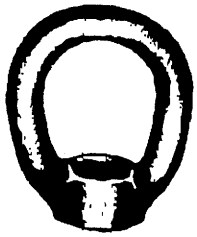
C206-0178

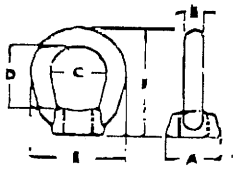
EYENUTS, STANDARD

Most commonly used for deadending, back-guying, and attaching pole head guys on the threaded ends of crossarm bolts. Drop-forged hot dip galvanized steel.

Catalog No.	Dimensions In Inches							Approx. Wt. Lbs. Per 100 Pcs.
	For Bolt Dia.	A	B	C	D	E	F	
6500	1/2	1 1/8	1/2	1 1/8	1 1/8	2 1/8	2 1/8	51
6501	3/4	1 1/4	1/2	1 1/4	1 1/4	2 1/8	2 1/8	46
†*6502	5/8	1 3/8	1/2	1 1/2	1 3/4	2 1/4	3	61
6503	3/4	1 3/8	1/2	1 1/2	1 3/4	2 1/2	3	54

*NEMA Standard
†RUS listed





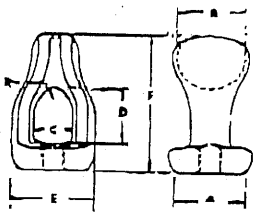
No. 6502

EYENUTS, THIMBLEYE®

For attaching to thru-bolts or threaded end of straight or angle-Thimbleye bolts for straight-away head guys. Drop-forged galvanized steel. Nuts are contoured to minimize bending and kinking of guy strand.

Catalog No.	Tapped For	Dimensions In Inches							Approx. Wt. Lbs. Per 100 Pcs.
		A	B	C	D	E	F	R	
†6510	5/8 Bolt	1 1/2	1 1/2	7/8	1 3/8	1 7/8	3 1/4	1/4	78
*6511	3/4 Bolt	1 1/2	1 1/2	7/8	1 3/8	1 7/8	3 1/4	1/4	72

*ANSI Standard
†RUS listed



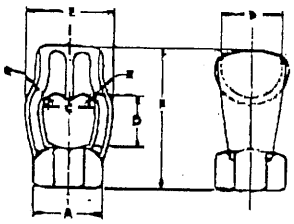
No. 6510

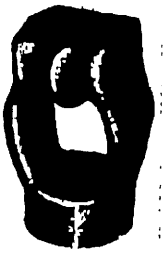
EYENUTS, TWINEYE®

Used for head or stub guying of two strands, Twineye Nuts can be attached to thru-bolts or threaded end of straight or angle Thimbleye bolts. Grooves are contoured to protect guy strands. Drop-Forged galvanized steel.

Catalog No.	Tapped For	Dimensions In Inches							Approx. Ship Wt. Lbs. Per 100 Pcs.
		A	B	C	D	E	F	R	
6560	5/8 Bolt	1 7/8	1 11/16	1 1/8	1 1/16	2 3/8	3 5/8	5/16	190
6561	3/4 Bolt	1 7/8	1 11/16	1 1/8	1 5/16	2 3/8	3 3/8	5/16	184
*6562	1" Bolt and PISA	1 7/8	1 11/16	1 1/8	1 5/16	2 3/8	3 3/8	5/16	183

6562 1" eyenut fits both 1" and 3/4" PISA rods.

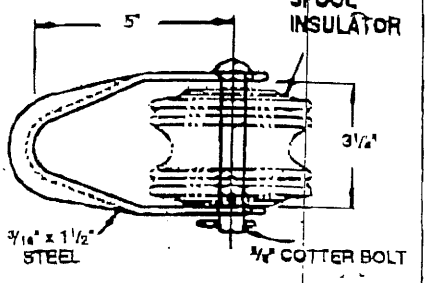




No. 6562

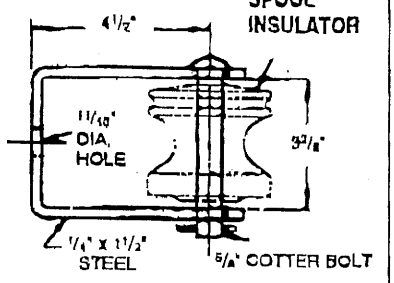
CLEVISES, INSULATED (Less Insulators)

NEMA 53-4 PORCELAIN SPOOL INSULATOR



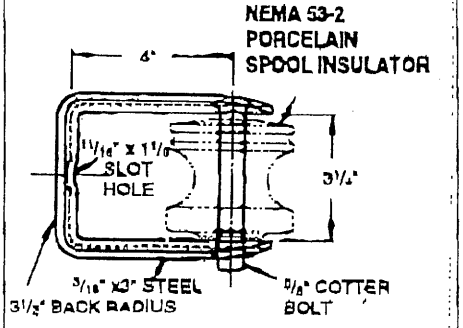
No. 0352 — Wt. per 100 pcs. 152 lb.
RUS listed

NEMA 53-2 PORCELAIN SPOOL INSULATOR



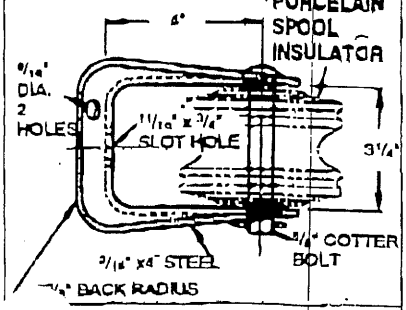
No. *0322 — Wt. per 100 pcs. 186 lb.

NEMA 53-2 PORCELAIN SPOOL INSULATOR



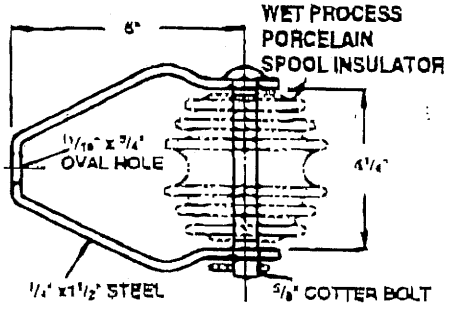
No. *0337 — Wt. per 100 pcs. 240 lb.
No. 0338 Clevis is identical to No. 0337 except length from back of clevis to cotter bolt is 3" insted of 4" and weight is 204 lb.

NEMA 53-4 PORCELAIN SPOOL INSULATOR



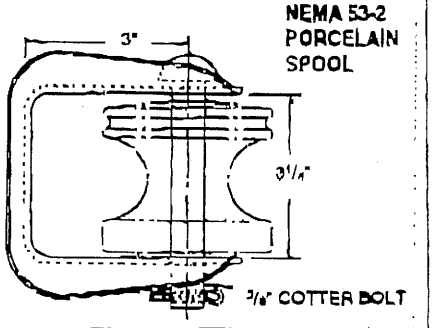
*0327 — Wt. per 100 pcs. 276 lb.
...listed

NEMA 53-5 WET PROCESS PORCELAIN SPOOL INSULATOR



No. *0344 — Wt. per 100 pcs. 272 lb.

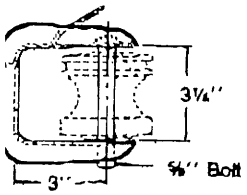
NEMA 53-2 PORCELAIN SPOOL



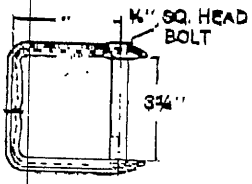
No. *C207-0024 — Wt. per 100 pcs. 184 lb.

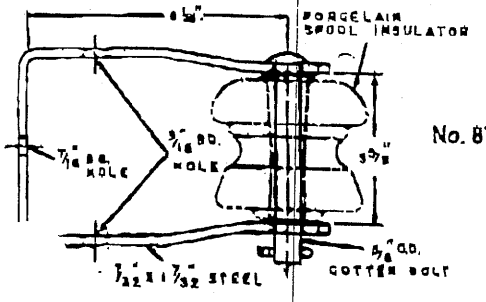
*NEMA Standard

NEMA 53-2 INSULATOR No. C207-0072



USE NEMA 53-3 INSULATOR No. C207-0116





No. 8795

CLEVISES, INSULATED (Less Insulators)

Sagger Bracket

Double duty bracket may be used to support conductor during stringing operations and then may be rotated upright to become a permanent clevis. Catalog Number C207-0072 has same overall dimensions as C207-0024 clevis.

Catalog No.	Description	Approx. Ship Wt. Lbs. Per 100 Pcs.
C207-0072	Sagger Bracket – Less Insulator	140
C207-0116	Sagger Bracket – Less Insulator	240

Crossarm Mounting Bracket

For attachment over crossarm with a 1/2" carriage bolt installed vertically through the arm, or a 3/8" lag screw.

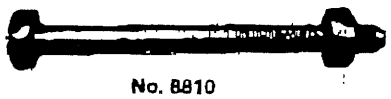
Catalog No.	Description	Approx. Ship Wt. Lbs. Per 100 Pcs.
8795	Clevis – less insulator	192

BOLTS, MACHINE

Are also called crossarm bolts or through bolts. Bolts have rolled threads and one square nut. Bolts six inches or longer have cone-type points. Hot dip galvanized.

Cat. No.	Dim. in Inches: Bolt Length	Dim. in Inches: Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
3/8-Inch Diameter			
8504	4	3	15
8504½	4½	3	17.2
*8505	5	3	18.8
8505½	5½	3	12.8
4,250 Pound Rated Tensile Strength			
½-Inch Diameter			
8701½	1½	1¼	17.8
*8704½	4½	3	33
*8705	5	3	35
†8706	6	3	39
†8707	7	3	45
†*8708	8	4	48
†8709	9	4	57
†*8710	10	4	60
*8712	12	5	71
8714	14	6	79
7,600 Pound Rated Tensile Strength			
⅝-Inch Diameter			
8805	5	3	60
†*8806	6	3	69
*8807	7	4	75
†*8808	8	4	78
†8809	9	4	84
†*8810	10	6	99
†*8812	12	6	112
†*8814	14	6	124
†*8816	16	6	134
†*8818	18	6	149
†*8820	20	6	164
†8822	22	6	176
†8824	24	6	194
12,400 Pound Rated Tensile Strength			
¾-Inch Diameter			
†*8908	8	4	126
†*8910	10	6	164
†*8912	12	6	186
†*8914	14	6	188
†*8916	16	6	225
†*8918	18	6	232
†8920	20	6	252
†8922	22	6	288
†8924	24	6	304
†8926	26	6	308
18,350 Pound Rated Tensile Strength			
⅞-Inch Diameter			
†*C205-0254	14	6	284
†*C205-0256	16	6	302
†C205-0258	22	6	426
†*C205-0256	16	6	316
†C205-0257	20	6	390
25,400 Pound Rated Tensile Strength			

*ANSI Standard
†RUS Listed



No. 8810

No. 8505½

BOLTS, OVALEYE

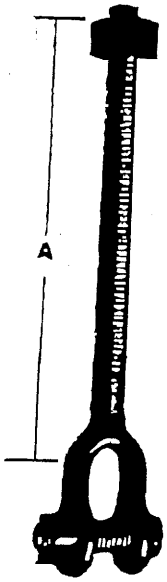
Bolts with ⅝" and ¾" shanks have 1½" x 2" ovaleyes. Drop-forged, galvanized steel bolts have cone type points and rolled threads.

Catalog No.	Length Under Eye Inches	Thread Length Inches	Approx. Ship Wt. Lbs. Per 100 Pcs.
½-Inch Shank Diameter 7/16" x 1 1/8" x 1 5/8" Ovaleye			
*29939	6	4	77
*29943	12	6	100
7,800 Pound Rated Tensile Strength			
⅝" Shank Dia — 9/16" x 1 7/16" x 2" Ovaleye			
†29956	8	4	100
†*29958	8	4	104
*29959	9	4	113
†*29960	10	6	122
†*29962	12	6	144
†*29964	14	6	146
†29966	16	6	165
†29968	18	6	206
†29970	20	6	220
12,400 Pound Rated Tensile Strength			
¾" Shank Dia — ¾" x 1 7/16" x 2" Ovaleye			
†29978	8	4	180
†29980	10	4	200
†29982	12	6	228
*29984	14	6	248
†29986	16	6	268
†29988	18	6	314
18,350 Pound Rated Tensile Strength			

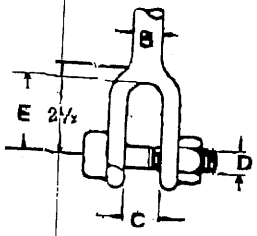
*NEMA Standard
†RUS Listed

No. 29960

BOLTS, CLEVIS



No. 15828

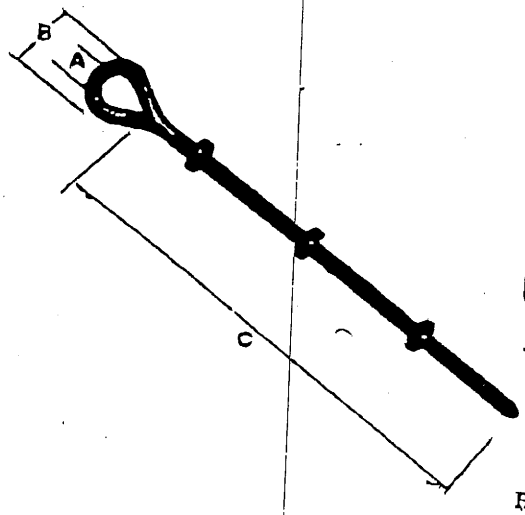


For supporting crossarm suspension insulator strings. Cotter bolt is 2¾" long and comes with cotter pin and hex nut. Clevis Bolts are drop-forged steel. Hot dip galvanized.

Catalog No.	Dimensions in Inches A	B	C	D	E	Thread Length	Approx. Ship Wt. Lbs. Per 100 Pcs.
†15808	8	5/8	13/16	1/2	1 13/16	6	150
†15810	10	5/8	13/16	1/2	1 13/16	6	199
†15812	12	5/8	13/16	1/2	1 13/16	6	217
†15814	14	5/8	13/16	1/2	1 13/16	6	220
†15828	8	3/4	13/16	5/8	1 13/16	6	200
†15830	10	3/4	13/16	5/8	1 13/16	6	267
†15832	12	3/4	13/16	5/8	1 13/16	6	280
†15834	14	3/4	13/16	5/8	1 13/16	6	304

†RUS Listed
5/8" Bolt has 12,400 Pound Rated Tensile Strength
3/4" Bolt has 18,350 Pound Rated Tensile Strength

BOLTS, DOUBLE-ARMING EYE



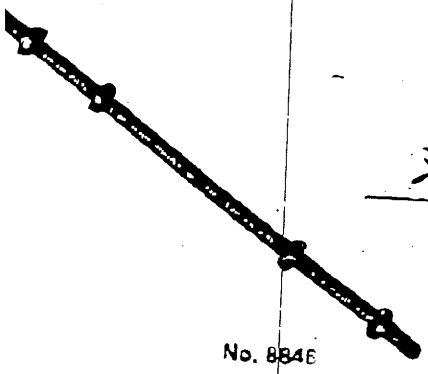
Bolts have a cone type point and are threaded to within 2" of the 1½" x 2" eye. Three Square Nuts. Drop-forged steel. Hot dip galvanized.

5/8-Inch Diameter

Catalog No.	Inside Dim. A	Outside Dim. B	Length Under Eye C (Inches)	Approx. Ship Wt. Lbs. Per 100 Pcs.
†19784	1 1/2	2 5/8	14	196
†19786	1 1/2	2 5/8	16	220
†19788	1 1/2	2 5/8	18	232
†19790	1 1/2	2 5/8	20	256
†19792	1 1/2	2 5/8	22	260

12,400 Pound Rated Tensile Strength
†RUS Listed

BOLTS, DOUBLE-ARMING FULL THREAD



No. 8846

Bolts permit replacement ease in double arms and offer added flexibility of use. Cone type point for easy starting and driving-out without damage to threads. Each bolt provided with four square nuts. Hot dip galvanized steel.

Catalog No.	Length, Inches	Approx. Ship Wt. Lbs. Per 100 Pcs
8846	16	117

1/2-Inch Shank Diameter

Catalog No.	Length, Inches	Approx. Ship Wt. Lbs. Per 100 Pcs
8848	18	125

5/8-Inch Diameter

†*8862	12	126
†*8864	14	156
†*8866	16	176
†*8868	18	196
†*8870	20	204
†*8872	22	220
†*8874	24	240
8876	26	256
8877	28	268
8878	30	270
8879	32	280

12,400 Pound Rated Tensile Strength
*ANSI Standard
†RUS Listed

3/4-Inch Diameter

C205-0140	6	128
C205-0141	8	150
*8882	12	234
*8884	14	240
*8886	16	248
*8888	18	272
†*8890	20	292
†*8892	22	316
†*8894	24	328
8896	26	365

18,350 Pound Rated Tensile Strength

GALVANIZED WIRE & STRAND

7-WIRE GALVANIZED STEEL STRAND
CLASS A, B, AND C COATING

NOMINAL STRAND DIA. INCHES (mm)	NOMINAL WIRE DIA. INCHES (mm)	NET WEIGHT POUNDS PER 1,000 FT (kg/m)	MINIMUM STRENGTH IN POUNDS (kN)	% ‡ ELONGATION
		SIEMENS-MARTIN		
1/4 (6.35)	0.080 (2.03)	121 (.180)	3,150 (14.01)	8
5/16 (7.94)	0.014 (2.64)	205 (.305)	5,350 (23.80)	8
3/8 (9.52)	0.120 (3.05)	273 (.407)	6,950 (30.92)	8
7/16 (11.11)	0.145 (3.68)	399 (.594)	9,350 (41.59)	8
1/2 (12.70)	0.165 (4.19)	517 (.768)	12,100 (53.82)	8
9/16(14.29)	0.188 (4.78)	671 (.997)	15,700 (69.84)	8
5/8 (15.88)	0.207 (5.26)	813 (1.211)	19,100 (84.96)	8
		HIGH STRENGTH		
3/16 (4.79)	0.062 (1.57)	73 (.108)	2,850 (12.68)	5
1/4 (6.35)	0.080 (2.03)	121 (.180)	4,750 (21.13)	5
5/16 (7.94)	0.104 (2.64)	205 (.305)	8,000 (35.59)	5
3/8 (9.52)	0.120 (3.05)	273 (.407)	10,800 (48.04)	5
7/16 (11.11)	0.145 (3.68)	399 (.594)	14,500 (64.50)	5
1/2 (12.70)	0.165 (4.19)	517 (.768)	18,800 (83.63)	5
9/16 (14.29)	0.188 (4.78)	671 (.997)	24,500 (108.98)	5
5/8 (15.88)	0.207 (5.26)	813 (1.211)	29,600 (131.67)	5
		EXTRA HIGH STRENGTH		
3/16 (4.76)	0.062 (1.57)	73 (.108)	3,990 (17.75)	4
1/4(6.35)	0.080(2.03)	121 (.180)	6,650 (29.58)	4
5/16 (7.96)	0.104 (2.64)	205 (.305)	11,200 (49.82)	4
3/8 (9.52)	0.120 (3.05)	273 (.407)	15,400 (68.50)	4
7/16 (11.11)	0.145 (3.68)	399 (.594)	20,800 (92.52)	4
1/2 (12.70)	0.165 (4.19)	517 (.768)	26,900 (119.66)	4
9/16 (14.29)	0.188 (4.78	671 (.997)	35,000 (155.69)	4
5/8 (15.88)	0.207 (5.26)	813 (1.211)	42,400 (188.60)	4
		UTILITIES		
3/16 (4.76	0.065 (1.65)	80 (.118)	2,400 (10.68)	10
5/16 (7.94)	0.109 (2.77)	225 (.335)	6,000 (26.69)	10
3/8 (9.52)	0.120 (3.05)	273 (.407)	11,500 (51.16)	4
7/16 (11.11)	0.145 (3.68)	399 (.594)	18,000 (80.07)	4
1/2 (12.70)	0.165 (4.19)	517 (.768)	25,000 (111.21)	4

‡ Minimum Elogation in a 24- in gauge length of galvanized strand

REA Approvals

The CCA Pole Dimension Table

Class	H-4	H-3	H-2	H-1	1	2	3	4	5	6	7	8	10
Minimum Circumference at Top (inches)	35	33	31	29	27	25	23	21	19	17	15	15	12
Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (inches)												
Southern Pine													
20	–	–	–	–	31.0	29.0	27.0	25.0	23.0	21.0	19.5	17.5	14.0
25	–	–	–	–	33.5	31.5	29.5	27.5	25.5	23.0	21.5	19.5	15.0
30	–	–	–	–	36.5	34.0	32.0	29.5	27.5	25.0	23.5	20.5	–
35	–	–	43.5	41.5	38.0	36.5	34.0	31.5	29.0	27.0	25.0	–	–
40	51.0	48.5	46.0	43.5	41.0	38.5	36.0	33.5	31.0	28.5	–	–	–
45	53.6	51.0	48.5	45.5	43.0	40.5	37.5	35.0	32.5	30.0	–	–	–
50	56.5	53.0	50.5	47.5	45.0	42.0	39.0	36.5	34.0	–	–	–	–
55	58.0	55.0	52.0	49.5	46.5	43.5	40.5	38.0	–	–	–	–	–
60	59.5	57.0	54.0	51.0	48.0	45.0	42.0	39.0	–	–	–	–	–
65	61.5	58.5	55.5	52.5	49.5	46.5	43.5	40.5	–	–	–	–	–
70	63.5	60.5	57.0	54.0	51.0	48.0	45.0	41.5	–	–	–	–	–
75	65.0	62.0	59.0	55.5	52.5	49.0	46.0	–	–	–	–	–	–
80	66.5	63.5	60.0	57.0	54.0	50.5	47.0	–	–	–	–	–	–
85	68.0	65.0	61.5	58.5	55.0	51.5	48.0	–	–	–	–	–	–
90	69.5	66.5	63.0	59.5	56.0	53.0	49.0	–	–	–	–	–	–
95	71.0	67.5	64.5	61.0	57.0	54.0	–	–	–	–	–	–	–
100	72.5	69.0	65.5	62.0	58.5	55.0	–	–	–	–	–	–	–
105	74.0	70.5	67.0	63.0	59.5	56.0	–	–	–	–	–	–	–
110	75.0	71.5	68.0	64.5	60.5	57.0	–	–	–	–	–	–	–
115	76.5	72.5	69.0	65.5	61.5	58.0	–	–	–	–	–	–	–
120	77.5	74.0	70.0	66.5	62.5	59.0	–	–	–	–	–	–	–
125	78.5	75.0	71.0	67.5	63.5	59.5	–	–	–	–	–	–	–
Jack Pine, Red Pine, Lodgepole Pine													
20	–	–	–	–	32.5	30.5	28.5	26.5	24.5	22.5	21.0	18.0	14.5
25	–	–	–	–	35.0	33.5	31.0	29.0	27.0	25.0	23.0	20.0	15.5
30	–	–	–	–	38.0	36.5	34.0	31.5	29.0	27.0	25.0	21.0	–
35	–	–	–	–	41.5	38.5	36.0	33.5	31.0	28.5	26.5	–	–
40	–	–	–	–	44.0	41.0	38.0	35.5	33.0	30.5	–	–	–
45	–	–	–	–	46.0	43.0	40.0	37.0	34.5	32.0	–	–	–
50	–	–	–	–	48.0	45.0	42.0	39.0	36.0	–	–	–	–
55	–	–	–	–	49.5	46.5	43.5	40.5	–	–	–	–	–
60	–	–	–	–	51.5	48.0	45.0	42.0	–	–	–	–	–
65	–	–	–	–	53.0	49.5	46.0	43.0	–	–	–	–	–
70	–	–	–	–	54.5	51.0	47.5	44.5	–	–	–	–	–
75	–	–	–	–	56.0	52.5	49.0	–	–	–	–	–	–
80	–	–	–	–	57.5	54.0	50.5	–	–	–	–	–	–
85	–	–	–	–	58.5	55.0	51.5	–	–	–	–	–	–
90	–	–	–	–	60.0	56.5	52.5	–	–	–	–	–	–
Ponderosa Pine Western Red Cedar*													
20	–	–	–	–	33.5	31.5	29.5	27.0	25.0	23.0	21.5	18.5	15.0
25	–	–	–	–	37.0	34.5	32.5	30.0	28.0	25.5	24.0	20.5	16.5
30	–	–	–	–	40.0	37.5	35.0	32.5	30.0	28.0	26.0	22.0	–
35	–	–	48.0	45.5	42.5	40.0	37.5	34.5	32.0	30.0	27.5	–	–
40	56.5	53.5	51.0	48.0	45.0	42.5	39.5	36.5	34.0	31.5	–	–	–
45	59.0	56.0	53.5	50.5	47.5	44.5	41.5	38.5	36.0	33.0	–	–	–
50	61.5	58.5	55.5	52.5	49.5	46.5	43.5	40.0	37.5	–	–	–	–
55	64.0	61.0	57.5	54.5	51.5	48.5	45.0	42.0	–	–	–	–	–
60	66.0	63.0	59.5	56.5	53.5	50.0	46.5	43.5	–	–	–	–	–
65	68.0	65.0	61.5	58.5	55.0	51.5	48.0	45.0	–	–	–	–	–
70	70.0	67.0	63.5	60.0	56.5	53.0	49.5	46.0	–	–	–	–	–
75	72.0	68.5	65.0	61.5	58.0	54.5	51.0	–	–	–	–	–	–
80	74.0	70.5	67.0	63.0	59.5	56.0	52.0	–	–	–	–	–	–
85	75.5	72.0	68.5	64.5	61.0	57.0	53.5	–	–	–	–	–	–
90	77.0	73.5	70.0	66.0	62.5	58.5	54.5	–	–	–	–	–	–
95	79.0	75.0	71.5	67.5	63.6	59.6	–	–	–	–	–	–	–
100	80.5	76.5	72.5	69.0	65.0	61.0	–	–	–	–	–	–	–
105	82.0	78.0	74.0	70.0	66.0	62.0	–	–	–	–	–	–	–
110	83.5	79.5	75.5	71.5	67.6	63.0	–	–	–	–	–	–	–
115	84.5	80.5	76.5	72.5	68.5	64.0	–	–	–	–	–	–	–
120	86.0	82.0	78.0	74.0	69.5	65.0	–	–	–	–	–	–	–
125	87.5	83.0	79.0	75.0	70.6	66.0	–	–	–	–	–	–	–

[illegible] of H Classes are applicable for western red cedar only.
[illegible] NATIONAL STANDARD 05.1

Treatment Specifications

To order your CCA wood pole and to be sure you obtain the oxide formulation, the following should be part of your specifications:

Treatment with CCA-C oxide preservatives.

All poles shall meet the requirements of the latest revision of A.N.S.I. 05.1 "Specifications and Dimensions for Wood Poles."

Poles will be treated in accordance with the requirements of the American Wood-Preservers' Association Standard C1, "All Timber Products - Preservative Treatment by Pressure Process," and C4, "Preservative Treatment with Water-borne Preservatives," except as noted in this specification.

Conditioning

- Poles should have a moisture content of 35% or less in the third inch from the surface of the pole.
- Only air-drying and kiln-drying are permitted.
- Poles must be cool prior to treatment.
- Heating poles in the preservative is not permitted.

Fixation

- A maximum fixation period of six hours by heating in steam or hot water at 220°F. is permitted in southern pine poles only.

Retention of Treatment

- Retention - Poles are to be treated to a retention level of 0.60 pcf as determined by an assay of the 0.50"-2.0" zone (southern and ponderosa pine), 0.10"-0.75" zone (lodgepole and jack pine), 0.10"-1.60" zone (red pine), or 0.10"-0.[illegible]" zone (western red cedar).
- Penetration - Poles shall be penetrated in accordance with A.W.P.A. Standard No. 3.2.

7. Retreatment
   - Poles may be retreated, providing none of the limitations specified in A.W.P.A. Standard C1, paragraph 6-retreatment are exceeded.
8. Chemical Constituents
   - CCA-Type C waterborne preservatives used in the treatment of utility poles shall be of the oxide form and not use constituents copper sulfate, sodium arsenate, or pyro-arsenate, potassium or sodium dichromate, or other constituents that will form water soluble electrolytes in utility poles.
9. Species
   - Only southern pine, red pine, lodgepole pine, ponderosa pine, Jack pine (Canada) and western red cedar poles can be treated effectively with CCA preservatives.

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is promulgated according to a consensus procedure and is under the jurisdiction of AWPA Subcommittee T-4)

C4-99°

This Standard is expressed in metric units with English units shown in parentheses.

POLES - PRESERVATIVE TREATMENT BY PRESSURE PROCESSES

Note: AWPA Standard C4-99 consists of eight pages.

Note: AWPA Standard C4, covers preservative treatment requirements for poles. When buying under this Standard, however, purchase orders, to be complete, should cover the following: Species, quality of poles before treatment, size requirements, surface preparation limitations (if any), special conditioning requirements, preservative, preservative retention, and method of retention determination if more than one is indicated in Par. 3.1 of this Standard. AWPA Standard M1, Standard for the Purchase of Treated Wood Products, provides general information for the purchaser who is unfamiliar with wood preservatives and wood preservation procedures. Standard C4 is to be used in conjunction with AWPA Standard C1, All Timber Products-Preservative Treatment by Pressure Processes, and Standard C1 is hereby made a part of this Standard.

Major regional differences in potential for deterioration of wood used in contact with the ground are shown in Figure 1 of this Standard. With preservatives for which multiple retentions are given, users have opportunity to develop management plans (retention specifications and/or maintenance programs) that address the environmental challenge in their region. Such plans should recognize that in certain modified environments such as banks along irrigation canals, irrigated residential or agricultural lands, a higher degree of protection might be needed than would be required in local, natural environment. It must also be recognized that within individual regions, certain natural sub-environments such as river valleys or coastlines may present greater potential for wood deterioration than the region, as a whole. Users should consult the Deterioration Zones Map shown in Figure 1 of this Standard when determining the preservative retention level. The higher retention level shall be specified when poles are to be installed in the higher deterioration zones. See Deterioration Zones map on the following page.

On succeeding pages are given specific requirements for the treatment of poles of the following species:

Treatment with Creosote & Oil-Borne Preservatives

Pages 3 and 4
Southern Pine
Coastal Douglas-fir
Jack Pine

Page 5
Red Pine
Lodgepole Pine
Western Red Cedar
Alaska Yellow Cedar

Page 6
Western Larch
Ponderosa Pine

Page 7
Treatment with Waterborne Preservatives
All Species Listed Above.
Discontinued Species

1. SPECIFIC REQUIREMENTS -- TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of American Wood-Preservers' Association Standard C1 All Timber Products – Preservative Treatment by Pressure Processes. See AWPA Standards M1, M2, M3, M4, and M13 for additional information.

	Southern Pine		Coastal Douglas-Fir	Jack Pine
1.3 Conditioning	Air-seasoning, kiln drying, steaming, heating in the preservative, or a combination.		Air-seasoning, kiln drying, Boulton drying, heating in the preservative, or a combination	Air-seasoning, kiln drying, steaming, (for ice-coated or frozen poles only), heating in the preservative or a combination.
1.3.2 Steaming				
Temp. – deg C (deg. F) -- Max		116 (240)	Not permitted	116 (240)
Duration – hr. – Max				
Total of Initial (Par 1.3.1) plus Final (Par 2.2.4)	Group A: 17	Group B: 20		4
Vacuum				
kPa (in.) at sea level -- Min.		509 (27)		509 (27)
1.3.3 Heating in Preservative				
Temp. – deg C (deg F) – Max		104 (220)	104 (220)	104 (220)
Duration – hr. – Max		No time limit	No time limit	No time limit
2. TREATMENT				
2.2.2 Pressure – kPa (psig) – Max		1400 (200)	1050 (150)	1050 (150)
2.2.3 Expansion Bath				
Temp. – deg C (deg. F) – Max		104 (220)	104 (220)	104 (220)
2.2.4 Final Steaming [note 1]				
Temp. – deg C (deg. F) -- Max		116 (240)	116 (240)	116 (240)
Duration – hr. -- Max.		3	3	3
3. RESULTS OF TREATMENT				
3.1 Retention – Min by assay in kg/m³ (pcf)				
Sampling zone for assay -- millimeters (inches) from surface		11 to 50 mm (0.50 to 2.00 in.)	6 to 25 mm (0.25 to 1.00 in.)	3 to 19 mm (0.10 to 0.75 in.)
For deep incised or radial drilled poles, in addition			50 to 63 mm (2.00 to 2.50 in.) or the inner 13 mm (1/2 inch) of the depth of penetration specified, when deeper penetration is specified by the purchaser	
Number of borings, each and every charge		20	20	20
Creosote and Creosote Solution				
Standards P1/P13 and P2				
– By assay -- Kg/m³ [pcf]				
Outer zone	96 (6.0)	120 (7.5)	144 (9.0)	144 (9.0) 192 (12.0) 272 (17.0)
Inner zone when required				72 (4.5) 96 (6.0) 192 (12.0) 256 (16.0)
Oil-Borne Preservatives				
Copper Naphthenate, Standards P8 & P9 (Type A only) by assay – kg/m3 (pcf)				
Outer zone (Oil as metal)	0.96 (0.06)	1.28 (0.08)	2.08 (0.130)	1.2 (0.075) 1.6 (0.095) 2.4 (0.150) 1.6 (0.095) 1.9 (0.120)
Inner zone when required				0.61 (0.038) 0.79 (0.049) 1.2 (0.075)
Pentachlorophenol, Standards P8 & P9 (Types A and C) [note 5] – By assay [note 2]				
Outer zone	4.8 (0.30)	6.1 (0.38)	7.2 (0.45) [Note 3]	7.2 (0.45) 9.6 (0.60) 12.8 (0.80)
Inner zone when required				3.7 (0.23) 4.8 (0.30)

3.2 Penetration in mm (in.) of wood and/or percent of sapwood – Minimum (C1, 7.2.1)	63 mm (2.50 in) or 95%	75 mm (3.00 in) or 90%	90 mm (3.50 in) or 80%	19 mm (0.75 in.) and 65% of sapwood	38 mm (1.50 in.) and 80 % of sapwood
For deep incised or radial drilled poles, Min. mm (in.)				63 mm (2.5 in.) or to basic depth of deep incising or radial drilling specified	
3.2.1 Determination of Penetration (note 4)					
3.2.1.1 Group A poles whose 1.8m (6ft) from butt circumference is less than 950 mm (37.5 inches).	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of 20 poles in each charge. If 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be retested. If 16 or 17 of the borings meet the requirements each Group A pole in the charge shall be bored and only those meeting the requirement shall be accepted. If less than 16 of the borings meet the requirement of Group A poles in the charge shall be rejected.				
3.2.1.2 Group B – poles whose 1.8 m (6 ft.) from butt circumference is 950 mm (37.5 inches) or more.	A borer core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of each pole and only those meeting the penetration requirements shall be accepted. On poles 15 m (50 ft.) and longer (except WRC) each pole will be bored twice at 90° apart. Only those poles meeting the penetration requirements on both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in a plane approximately 300 to 600 mm (1 to 2 ft.) above the brand. Deep incised or radial drilled poles shall have the borings taken at least 300 mm (one ft.) above the standard ground line and about one ft. below the top of the deep incising or radial drilling section and shall be taken on any diagonal of the diamond pattern and not directly in the center of the four incisions of the diamond pattern.				
4 PRESERVATIVES	All standard preservatives listed above		All standard preservatives listed above		All standard preservatives listed above
5 RETREATMENT (note 1)	Poles may be retreated providing none of the limitations specified in AWPA Standard C1, par. 8 (Retreatment), are exceeded.				

[1] Retreatment of Stored Poles – Poles treated within the current calendar year as well as those treated in the period one calendar years previously, as indicated by the date on the face brand and/or bull marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if not size is less than standard, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

[2] When the copper pyridine method is used, multiply the result by 1.1 to convert to fire ignition result.

[3] Perchlorophenol solvent systems Types B and D for Southern Pine were deleted from the Standard in 1989 without prejudice due to non-use.

[4] Penetration must be continuous through both sapwood and heartwood on each annual ring.

[5] Treating solution concentration: Min. 5%, Max. 9%.

1. SPECIFIC REQUIREMENTS – TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of American Wood-Preservers' Association Standard C1, All Timber Products – Preservative Treatment by Pressure Processes, except as modified or supplemented by the following note. Users of this Standard should refer to AWPA Standards M1, M2, M3, M4 and M19 for additional information.

	Red Pine	Lodgepole Pine	Western Red Cedar Alaska Yellow Cedar
1.3 Conditioning	Air-seasoning, kiln drying, steaming, hard- ing in the preservative, or a combination.	Air-seasoning, kiln drying, diffusion drying, heating in the preservative, or a combination.	Air-seasoning, kiln drying, steaming, (for ice-coated or frozen poles only), heating in the preservative or a combination.(3)
1.3.2 Steaming			
Temp. – deg C (deg. F) – Max.	116 (240)	116 (240)	116 (240)
Duration – hr. – Max.			
Total of Initial (Par. 1,3,2) plus final (Par. 2,2,4)	4	4	4
Vacuum			
kPa (in. Hg) at sea level – Min	-77kPa (22 in Hg)	-77kPa (22 in Hg)	-77kPa (22 in Hg)
1.3.3 Heating in Preservative			
Temp. – deg C (deg. F) – Max	104 (220)	104 (220)	104 (220)
2. TREATMENT			
2.2.2 Pressure – kPa (psig) – Max.	1050 (150)	1050 (150)	700 (100)
2.2.3 Expansion Bath			
Temp. – deg C (deg. F) – Max.	104 (220)	104 (220)	104 (220)
2.2.4 Final Steaming(1)			
Temp. – deg C (deg. F) – Max.	116 (240)	116 (240)	116 (240)
Duration – hr. – Max.	3	4	5
3. RESULTS OF TREATMENT			
3.1 Retention – kg/m3 by assay in kg/m3 (pcf)			
Sampling zone for assay – millimetres (inches) from surface	2.5 to 41 mm (0.10 to 1.60 in.)	2.5 to 19 mm (0.10 to 0.75 in.)	0.00 to 13 mm (0.00 to 0.50 in.)
Number of borings, each and every charge.	20	20	20
Creosote and Creosote Solution Standards P1/P13 and P2			
– By assay in kg/m3 (pcf)	160 (10.0) 192 (12.0)	192 (12.0) 256 (16.0)	320 (20)
Oil-Borne Preservatives			
Copper Naphthenate, Standards P8 & P9 (Type A only) by assay, kg/m3 (pcf)	12.0 (0.075) 1.52 (0.095) 2.40 (0.150)	1.52 (0.095) 1.92 (0.120)	1.92 (0.120)
Pentachlorophenol, Standard P8 & P9 P8 & P9 (Types A,B, & C) (note 6) – By assay in kg/m3 (pcf) [note 4]	8.0 (0.50) 9.6 (0.60)	9.6 (0.60) 13 (0.80)	16 (1.0)
3.2 Penetration in millimetres (inches) of wood and/or percent of sapwood Minimum (C1, 3.2.1)	63 mm (2.50 in) or 85% 75 mm (3.00 in) or 90%	19mm (0.75 in.) and 85 % of sapwood	12mm (0.50 in.) or 100 % of Sapwood

3.2.1.1 Group A – poles whose 1.8 m (6 ft.) from butt circumference is less than 850 mm (37.5 in.)

A boring core shall be taken at a point in a plane approximately 300 to 600mm (1 to 2 ft.) below the brand 300mm (1 ft.) below the groundline in Western Red Cedar) of 20 poles in each charge, if 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be re-treated. If 16 or 17 of the borings meet the requirements, each Group A pole in the charge shall be bored and only those meeting the requirements shall be accepted. If less than 16 of the borings meet the requirement all Group A poles in the charge shall be rejected.

3.2.1.2 Group B – poles whose 1.8 m (6 ft.) from butt circumference is 850 mm (37.5 in.) or more

A boring core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand 300 mm (1 ft.) below the groundline in Western Red Cedar) of each pole and only those meeting the penetration requirements shall be accepted. On poles 13 m (50 ft.) and longer (except WRC) each pole will be bored twice at 90° apart. Only those poles meeting the penetration requirements in both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in plane approximately 300 to 600 mm (1 to 2 ft.) above the brand.

	All standard Preservatives listed above	All standard Preservatives listed above	All standard Preservatives listed above
4. PRESERVATIVES			

5. RETREATMENT (note 2) Poles may be retreated providing none of the limitations specified in AWPA Standard C1, par. 6 (Retreatment), are exceeded.

(2) Retreatment of Stored Poles -- Poles treated within the current calendar year as well as those treated in the period one calendar year previously, are indicated by the date on the hole brand and/or butt marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if not available less than adequate, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

(3) Heating in the preservative for purposes other than drying is permitted either at atmospheric pressure or under vacuum, provided that the temperature of the preservative does not exceed 93 degrees C (200°F).

(4) When the copper pyridine method is used, multiply the result by 1.1 to convert to lime ignition result.

(5) For oil-borne treatment of Red pine, the retention of 128 kg/m3 (8.0 pcf) creosote and 9.4 Kg/m3 (0.40 pcf) pentachlorophenol were deleted from the Standard in 1972 without prejudice for lack of use.

(6) Treating solution concentration: Min 5%, Max 9%.

1 SPECIFIC REQUIREMENTS – TREATMENT WITH CREOSOTE AND OIL-BORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of AWPA Standard C1 All Timber Products -- Preservative Treatment by Pressure Processes, except as modified or supplemented by the following table. Users of this Standard should refer to AWPA Standards M4, M2, M3, M4, and M10 for additional information.

	Western Larch	Douglas Fir
1.2 Conditioning	Air-seasoning, kiln drying, Boulton drying, heating in the preservative, or a combination	Air-seasoning, kiln drying, steaming, heating in the preservative, or a combination
1.3.2 Steaming		
Temp. -- deg C (deg. F) -- Max	Not Permitted	116 (240)
Duration -- hr. -- Max.		8 [note 1]
Vacuum		
kPa (in. Hg) at sea level -- Min		-77 kPa (22 in. Hg)
1.3.3 Heating in Preservative		
Temp. -- deg C (deg. F) -- Max.	Steamed: 99 deg C (210°F) and 8 hr. Green or partially seasoned, 104 deg C (220 deg F) and no time limit	104 (220) No time limit
Duration -- hr. -- Max		
2. TREATMENT		
2.2.2 Pressure -- kPa (psig) -- Max	1050 (150)	1400 (200)
2.2.3 Expansion Bath		
Temp. -- deg C (deg. F) -- Max.	104 (220)	104 (220)
2.2.4 Final Steaming(1)		
Temp. deg C (deg. F) -- Max	116 (240)	116 (240)
Duration -- hr. -- Max.	3	3 [note 1]
3. RESULTS OF TREATMENT		
3.1 Retention -- kilo. by assay kg/m3 (pcf)		
Sampling zone for assay -- millimeters (inches) from surface	2.5 to 15 mm (0.10 to 0.60 in.)	13 to 50 mm (0.50 to 2.00 in.)
Number of borings, each and every charge, Creosote and Creosote Solution Standards P1/P13 and P2	36	20
-- By assay in kg/m3 (pcf)	256 (16)	pa (6.0) 120 (7.5) 144 (9.0)
Oil-borne Preservatives		
Copper Naphthenate, Standards P8 & P9 -- By assay in kg/m3 (pcf)		0.96 (0.060) 1.28 (0.080) 2.08 (0.120)
Pentachlorophenol, Standard -- By assay in kg/m3 (pcf) [notes 3 & 5]	12.8 (0.8)	4.8 (0.30) 6.1 (0.38) 7.2 (0.48)
3.2 Penetration in millimeters (inches) of wood and/or percent of sapwood	12mm (0.50 in.) and 100% of sapwood up to a max. of 19 mm (0.75 in.)	62 mm (2.5 in) or 85% 75 mm (3.00 in) or 90% 87 mm (3.50 in) or 90%
Minimum (C1, 3.2.1)		
3.2.1 Determination of Penetration		

3.2.1.1 Group A -- poles whose 1.8 m (6 ft.) from butt circumference is less than 960 mm (37.5 in.)

A bore core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of 20 poles in each charge. If 18 of the borings meet the penetration, the Group A poles in the charge as a whole shall be accepted, but the non-conforming poles in the sample shall be retreated. If 16 or 17 of the borings meet requirements each Group A pole in the charge shall be bored and only those meeting the requirement shall be accepted. If less than 16 of the borings meet the requirements all Group A poles in the charge shall be rejected.

3.2.1.2 Group B -- poles whose 1.8 m (6 ft.) from butt circumference is 960 mm (37.5 in.) or more

A bore core shall be taken at a point in a plane approximately 300 to 600 mm (1 to 2 ft.) below the brand of each pole and only those meeting the penetration requirements shall be accepted. On poles 15.2 m (50 ft.) and longer (except westC) each pole will be bored at 90 degrees to each. Only those poles meeting the penetration requirements in both borings will be accepted. On poles 24 m (80 ft.) and longer, the boring shall be taken in a plane approximately 300 to 600 mm (1 to 2 ft.) above the brand.

4. PRESERVATIVES

All standard preservatives listed above

All standard preservatives listed above

5. RETREATMENT [note 2]

Poles may be retreated providing none of the limitations specified in Standard C1, part 8 (Retreatment), are exceeded.

(1)The total of the steaming time (para. 1.3.2) and the final steaming time (para. 2.2.4) shall not exceed 4 hours, with the exception that condemned piles may be for a total of 8 hours provided that the moisture content of the poles is reduced to 20 percent or less at 63 mm (2.50 in.) from the surface at mid-length when steaming commences. Otherwise, total steaming time permitted for this species is 4 hours.

[2] Retreatment of Stored Poles -- Poles treated within the current calendar year as well as those treated in the period one calendar year previously, as indicated by the date on the face brand and/or butt marking, are acceptable for shipment without retreatment. All other poles in storage are not acceptable for shipment without retreatment unless the preservative content of a standard sample (Paragraph 3.1) or, if lot size is less than standard, the composite assay result from all poles in the lot, meets the minimum retention requirements in Paragraph 3.1. If retreatment is required, no initial steaming shall be allowed, however, a final steam bath not to exceed 30 minutes will be used.

[3] When the copper pyridine method is used, multiply the result by 1.1 to convert to lime ignition result

[4] Treating solution concentration: Min. 3%, Max. 5%,

[5] Treating solution concentration, Min. 5%, Max. 9%.

1. SPECIFIC REQUIREMENTS – TREATMENT WITH WATERBORNE PRESERVATIVES

1.1 Poles shall be treated in accordance with the requirements of AWPA Standard C1 -- All Timber Products, Preservative Treatment by Pressure Processes, except as modified or supplemented in the following table. Specific requirements for waterborne treatments are the same as for treatment with creosote and oil-borne preservatives for the species being treated. Users of this Standard should refer to Standards M1, M2, M3, M4, and M13 for additional information.

1.2 The listing of Coastal Douglas-fir as an acceptable species for treatment with CCA is not intended to imply that this species can generally be satisfactorily treated. Treatment of this species is usually only satisfactory if the material chosen from permeable wood, selected by trials. If treatable wood is not available, the treatment of Coastal Douglas-fir with CCA is not recommended.

1.3 Conditioning	Air-seasoning, kiln drying, or a combination.
1.3.2 Steaming	Permitted (note 1)
1.3.3 Heating in Preservative	Not permitted

2. TREATMENT

2.2.2 Pressure – kPa (psig) – Max.	See previous pages of this Standard for maximum allowable pressure for the species being treated.
2.2.3 Expansion Bath	Not permitted
2.2.4 Final Steaming	Final steaming is not permitted except when solely performed to promote fixation as specified in Section 2.2.5.3

2.2.5 Fixation Period — When a post-treatment fixation process is specified as an optional process by the purchaser of Poles treated under this Standard, the following post-treatment processing limits have been found to significantly enhance preservative fixation while also avoiding conditions which would cause losses in mechanical properties. While the Chromotropic Acid Test (AWPA Standard A3, Method 11) is valid only for chromium-containing preservatives, comparable tests are being developed for other preservatives and will be incorporated as they become available. The time-temperature limitations specified below are appropriate for all species and all waterborne preservatives.

2.2.5.1 Liquid Processes

Temp. – deg. C (deg. F) – Max. 105°C (220°F)

Duration Until outer 0-12mm (0-0.5 in.) portion of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11) or not to exceed the Maximum time-temperature combinations listed below:

Temperature	Time
105°C (220°F)	6 hr
96°C (203°F)	9 hr
85°C (185°F)	12 hr
75°C (167°F)	18 hr
65°C (149°F)	24 hr

2.2.5.2 Air Processes

Dry-bulb Temp. – deg. C (deg. F) Any temperature above ambient (max. 71°C (160°F))

Max. wet-bulb Depression Temp. – deg. C (deg. F) 10°C (20°F)

Duration Until outer 0-12 mm (0-0.5 in.) of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11)

2.2.5.3 Steaming Processes

Temp. – deg. C (deg. F) – Max. 105°C (220°F)

Duration Until outer 0-12mm (0-0.5 in.) portion of 4 out of 5 borings per charge pass the Chromotropic acid test (AWPA Standard A3, Method 11) or Maximum time-temperature combinations listed below:

Temperature	Time
105°C (220°F)	6 hr
96°C (203°F)	9 hr
85°C (185°F)	12 hr
75°C (167°F)	18 hr
65°C (149°F)	24 hr

3. RESULTS OF TREATMENT

3.1 Retention – Min by assay in kg/m3 (pcf),	Same as for oil-borne preservatives
Sampling zone for assay	Same as for oil-borne preservatives
Number of borings, each and every charge.	

Continued on Next Page

ACA	9.6 (0.60)	4.8 (0.30)
ACQ Type B	9.6 (0.60)	4.8 (0.30)
CCA	9.6 (0.60)	4.8 (0.30)
ACZA	9.6 (0.60)	4.8 (0.30)

3.2 Penetration in mm (inches) of wood and/or percent of sapwood – Min. (C1, 3.2.1)

Same as for heaviest oil-borne preservatives

5. RETREATMENT [note 4]

Poles may be re-treated providing none of the limitations specified in Standard C1, par. 5 (Retreatment) are exceeded.

(1) Poles treated with ACA, ACZA and ACQ-B formulations may be steamed up to a maximum temperature of 116° C (240°F) for air-seasoned and kiln-dried southern pine, and western larch – 6 hrs; Coastal Douglas-fir – 8 hrs., all other species – 4 hrs. Poles treated with CCA formulations may be steamed only to remove ice or thaw frozen material in accordance with paragraph 1.3 of AWPA Standard C1.

(2) For greater accuracy, the use of actual specific gravity of the wood is preferred to using the assumed average species density. For reference analysis actual wood specific gravities must be determined and used. (See AWPA Standard A12.)

(3) Waterborne preservatives are available either as oxides which form non-ionizing compounds in the wood or as salts which leave non-ionizing and ionizing compounds in the wood. If there is a preference for one formulation as compared to the other, the purchaser should so specify.

(4) See Footnote 1, Page 4.

DISCONTINUED SPECIES

Species removed from this Standard due to non-use: Western Hemlock (1987), Spruce (1987).
Should any person wish to reinstate a standard for these species using standard preservatives, it may be done without the usual pre-investigation and data submission required for new species per usual practice.

FS and FD Cast Device Boxes: Malleable Iron, Aluminum

UNILETS® for use with Threaded Rigid Conduit and IMC. All Device Boxes have Ridge Top Construction.

Applications

- Accommodate wiring devices such as switches and receptacles.
- Provide excellent service in areas where boxes are subject to rough usage.
- Serve as pull boxes for conductors.
- Permit access to conductors for maintenance.
- Provide openings for making splices.
- Allow connections for branch conduit runs.
- FS and FD blank bodies—for special conduit-entrance arrangements.

Features: All FS and FD Boxes

- Corrosion-resistant—ideal for indoor and outdoor installations.
- Weatherproof, raintight and dust-tight when used with cast gasketed covers.
- FS and FD boxes take standard flush wiring devices.
- FD boxes take devices exceeding 1-5/8" in depth under fastening ears.
- Malleable iron for high tensile strength and ductility—provides greater resistance to impact and shock.
- Both malleable iron and aluminum boxes have ridge top construction for positive cover/gasket/box fit.
- Accurately tapped, tapered threads for tight, rigid joints, ground continuity.
- Complete selection of covers, receptacles, plugs, gaskets and accessories.
- Covers have captive stainless steel screws to speed installation, prevents loss of screws.
- Internal grounding screws standard.

Features: Cast Hub Boxes

❶ Available in single, two and three gang and tandem.

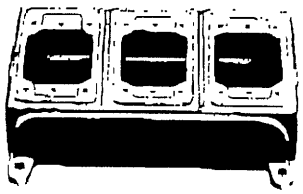
- Smooth, rounded integral bushing in each hub protects conductor insulation.

Features: FDB Blank Bodies for Drilling and Tapping

❷ Available in single, two and three gang boxes.

- Drilling and tapping from 1/2" thru 1-1/2".
- Minimum engagement of 3-1/2 threads.
- With mounting lugs.
- FDB-2GL and FDB-3GL can also be drilled and tapped in back of box (wall opposite cover).

❶ Cast Hub Boxes, Single Gang shown.



❷ Blank Bodies for Drilling and tapping. FDB-3L shown.

❸ Blank Bodies for Brazed Hubs. FS-2G shown.

Features: FS & FD Blank Bodies for Brazed Hubs

❸ Available in single, two, three and four gang boxes.

- Brazed threaded hubs for threaded conduit from 1/2" thru 1-1/2" and brazed union hubs from 1/2" thru 1-1/4.
- Smooth, rounded integral bushing in each hub protects conductor insulation.

Standard Materials

- *Cast Hub Device Boxes and Boxes for Drilling and Tapping:* malleable iron or copper-free (4/10 of 1% max.) aluminum.
- *Brazed Hubs:* malleable iron.
- *Covers:* malleable iron, steel, or copper-free (4/10 of 1% max.) aluminum.

Standard Finishes

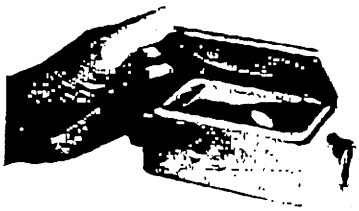
- *Malleable Iron Device Boxes:* triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat.
- *Aluminum Device Boxes:* epoxy powder coat.
- *Malleable Iron Covers with Gaskets:* triple-coat—(1) zinc electroplate, (2) dichromate, and (3) epoxy powder coat.
- *Steel Covers:* zinc electroplate.
- *Aluminum Covers:* epoxy powder coat.

Compliances

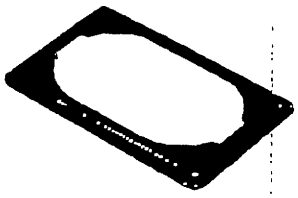
- UL Standard: 498 and 514A.
- U.S. Federal Specification W-C-586B.
- Appleton malleable iron products conform to ASTM A47-77, Grade 32510, which has the following properties: tensile strength, 50,000 psi; yield, 32,000 psi; and elongation, 10%.
- Appleton aluminum products are produced from a high strength copper-free (4/10 of 1% max.) alloy.

Reference Data

- When ordering drilled and tapped openings or brazed hubs for blank bodies, refer to "Ordering Information" pages.



Gasket is designed so that it wraps around ridge top of Appleton aluminum or malleable iron device box. Result is a positive seal against moisture.



Gasket construction. Cover tightens on largest perimeter of gasket and fits snugly against portion of gasket that wraps around ridge top of box.

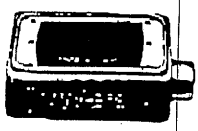
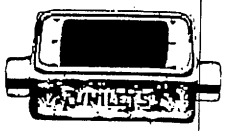
Effective October, 2001

EGS Appleton

7770 N. Frontage Road
Skokie, Illinois 60077

FS and FD Cast Device Boxes: Single Gang; Malleable Iron, Aluminum

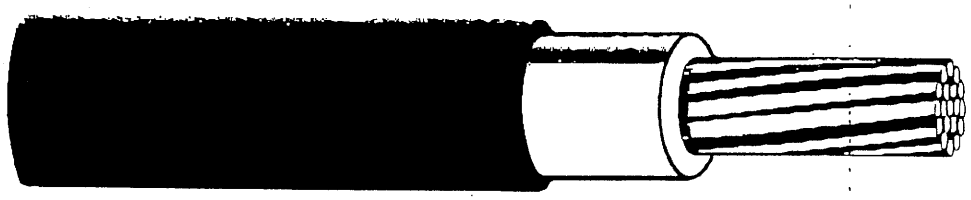
UNILETS® for use with Threaded Rigid Metal Conduit and IMC. FS Box 2.00" Deep, FD Box 2.69" Deep. Furnished with Internal Ground Screw.

	Type	Depth	Hub Size (Inches)	Catalog Number Malleable Iron Ridge Top	Catalog Number Aluminum Ridge Top
	FS	Shallow	1/2	FS-1-50	FS-1-50-A
			3/4	FS-1-75	FS-1-75-A
			1	FS-1-100	FS-1-100-A
	FD	Deep	1/2	FD-1-50	FD-1-50-A
			3/4	FD-1-75	FD-1-75-A
	FSC	Shallow	1/2	FSC-1-50	FSC-1-50-A
			3/4	FSC-1-75	FSC-1-75-A
			1	FSC-1-100	FSC-1-100-A
	FDC	Deep	1/2	FDC-1-50	FDC-1-50-A
			3/4	FDC-1-75	FDC-1-75-A
	FSS	Shallow	1/2	FSS-1-50	FSS-1-50-A
			3/4	FSS-1-75	FSS-1-75-A
	FDS	Deep	1/2	FDS-1-50	FDS-1-50-A
			3/4	FDS-1-75	FDS-1-75-A
			1	FDS-1-100	FDS-1-100-A
	FSLA	Shallow	1/2	FSLA-1-50	

EGS Appleton
7770 N. Frontage Road
Skokie, Illinois 60077

THHN

600 Volt, Copper Conductor, Thermoplastic Insulation/Nylon Sheath, Heat, Moisture, Oil, and Gasoline Resistant[1]. All Sizes Rated THWN-2. All Stranded Sizes Rated MTW. AWG Sizes 14 Through 6 Rated AWM (105°C). AWG Sizes 14 Through 1 Rated VW-1 and Larger Sizes Rated for CT Use.



APPLICATIONS

Southwire Type THHN or THWN-2 conductors are primarily used in conduit and cable trays for services, feeders, and branch circuits in commercial or industrial applications as specified in the National Electrical Code[2]. When used as Type THHN, conductor is suitable for use in dry locations at temperatures not to exceed 90°C. When used as Type THWN-2, conductor is suitable for use in wet or dry locations at temperatures not to exceed 90°C or not to exceed 75°C when exposed to oil or coolant. When used as Type MTW, conductor is suitable for use in wet locations or when exposed to oil or coolant at temperatures not to exceed 60°C or dry locations at temperatures not to exceed 90°C (with ampacity limited to that for 75°C conductor temperature per NFPA 79). Conductor temperatures not to exceed 105°C in dry locations when rated AWM and used as appliance wiring material. Voltage for all applications is 600 volts.

SPECIFICATIONS

Southwire Type THHN or THWN-2 or MTW (also AWM) meets or exceeds all applicable ASTM specifications, UL standard 83, UL standard 1063 (MTW), Federal Specification J-C-30B, and requirements of the National Electrical Code.

CONSTRUCTION

Southwire Type THHN or THWN-2 or MTW copper conductors are annealed (soft) copper, insulated with a tough heat and moisture resistant polyvinyl chloride (PVC), over which a nylon (polyamide) or UL-listed equal jacket is applied. Available in black, white, red, blue, green, yellow, brown, orange, and grey. Some colors standard, some subject to economic order quantity. Sizes 1 AWG through 1,000 kcmil available in black only.

[1] Oil and gasoline resistance II as defined by Underwriters Laboratories.
[2] 1999 Edition.

THHN

Conductor		Insulation Thickness (mils)	Jacket Thickness (mils)	Nominal O.D. (mils)		Approx. Net Weight Per 1000' (lbs.)		Allowable Ampacities+			Standard Package
Size (AWG or kcmil)	No. Strands			Sol.	Str.	Sol.	Str.	60 C	75 C	90 C	
**14	19*	15	4	102	109	15	16	15	15	15	DNF
**12	19*	15	4	119	128	23	24	20	20	20	DNF
**10	19*	20	4	150	161	37	38	30	30	30	DQF^
**8	19	30	5	--	213	--	63	40	50	55	F
**6	19	30	5	--	249	--	95	55	65	75	E
3	19	40	6	--	318	--	152	70	85	95	C
3	19	40	6	--	346	--	188	85	100	110	BC
2	19	40	6	--	378	--	234	95	115	130	C
1	19	50	7	--	435	--	299	110	130	150	B
1/0	19	50	7	--	474	--	371	125	150	170	B
2/0	19	50	7	--	518	--	461	145	175	195	B
3/0	19	50	7	--	568	--	574	165	200	225	B
4/0	19	50	7	--	624	--	717	195	230	260	B
250	37	60	8	--	694	--	850	215	255	290	B
300	37	60	8	--	747	--	1011	240	285	320	B
350	37	60	8	--	796	--	1172	260	310	350	B
400	37	60	8	--	842	--	1333	280	335	380	B
500	37	60	8	--	925	--	1653	320	380	430	B
600	61	70	9	--	1024	--	1965	355	420	475	C
750	61	70	9	--	1126	--	2462	400	475	535	C
1000	61	70	9	--	1276	--	3255	455	545	615	C

**Construction available in sizes 14, 12, & 10 as Types THHN or THWN-2 or AWM only, suitable for 105 C appliance wiring material (AWM).

*Four 500' spools per carton.

^Two 500' spools per carton.

+Allowable Ampacities:

Allowable ampacities shown are for general use as specified by the National Electrical Code, 1999 Edition, section 310-16.

60 C - When terminated to equipment for circuits rated 100 amperes or less or marked for #14 through #1 conductors. MTW wet locations or when exposed to oil or coolant.

75 C - When terminated to equipment for circuits rated over 100 amperes or marked for conductors larger than #1. THWN-2 when exposed to oil or coolant, MTW dry locations.

90 C - THHN dry locations. THWN-2 wet or dry locations.

All AWG sizes 14 through 1 rated VW-1. Larger sizes rated for CT Use.

STANDARD PACKAGE CODE:

B - 1000' Reel
C - 500' Reel
D - 2500' Spool
E - 1000' Spool
F - 500' Spool
N - 2000' Carton
Q - 350' Carton

RECOMMENDED SAMPLE SPECIFICATIONS:

(MTW OR THHN OR THWN-2)

Conductors shall be UL-listed Type MTW or THHN or THWN-2 gasoline and oil resistant II, suitable for operations at 600 volts as specified in the National Electrical Code. AWG sizes 14 through 1 shall be rated VW-1, larger sizes shall be rated for CT use. Conductors shall be annealed copper, insulated with high-heat and moisture resistant PVC, jacketed with abrasion, moisture, gasoline, and oil resistant nylon or UL-listed equivalent, as manufactured by Southwire Company or approved equal.

(AWM)

Conductors shall be UL-listed Type THHN or THWN-2 or MTW or AWM, suitable for operation at 600 volts at conductor temperatures not to exceed 105°C.

Southwire

One Southwire Drive
Carrollton, GA 30119 USA
770/832-4242
www.southwire.com

Hot-Dipped Galvanized
Rigid Steel Conduit

DIMENSIONS

Trade Size (Inches)	Threads per Inch	Inside Diameter (Inches)	Outside Diameter (Inches)	Wall Thickness (Inches)	Length without coupling Feet and Inches)	Wheatland Minimum Weight per 100 ft. (10 ft. lengths with couplings)
½	14	0.622	0.840	.104	9-11¼	82
¾	14	0.824	1.050	.107	9-11¼	109
1	11½	1.049	1.315	.126	9-11	161
1¼	11½	1.380	1.660	.133	9-11	218
1½	11½	1.610	1.900	.138	9-11	263
2	11½	2.067	2.375	.146	9-11	350
2½	8	2.469	2.875	.193	9-10½	559
3	8	3.068	3.500	.205	9-10½	727
3½	8	3.548	4.000	.215	9-10¼	880
4	8	4.026	4.500	.225	9-10¼	1030
5	8	5.047	5.563	.245	9-10	1400
6	8	6.065	6.625	.266	9-10	1840

PACKAGING

Trade Size (Inches)	N.E.M.A. Color Code Thread Protectors	Pieces per Bundle	Quantity per Crane Lift	Feet per Lift	Wheatland Wt. per Crane Lift
½	Black	10	25 Bundles	2,500	2,050 lbs.
¾	Red	5	40 Bundles	2,000	2,180 lbs.
1	Blue	5	25 Bundles	1,250	2,013 lb.s
1¼	Red	–	90 Pieces	900	1,962 lbs.
1½	Black	–	80 Pieces	800	2,104 lbs.
2	Blue	–	60 Pieces	600	2,100 lbs.
2½	Black	–	37 Pieces	370	2,068 lbs.
3	Blue	–	30 Pieces	300	2,181 lbs.
3½	Black	–	25 Pieces	250	2,200 lbs.
4	Blue	–	20 Pieces	200	2,060 lbs.
5	Blue	–	15 Pieces	150	2,100 lbs.
6	Blue	–	10 Pieces	100	1,840 lbs.

Rigid Steel Conduit Specifications

Wheatland Hot-dipped Galvanized Rigid Steel Conduit is manufactured in conformance to standards established by the American National Standards Institute, the Underwriters Laboratories and the Federal Specification. In preparing bids, it may be stated that Wheatland Rigid Conduit conforms to:

- American National Standard Institute C80.1-
- Federal Specification WW-C-581
- Underwriters Laboratories Specification No. 6
- National Electrical Code—Article 346

UNDERWRITERS LABORATORIES SPECIFICATION NO. 6

The specifications for rigid steel conduit established by the Underwriters Laboratories cover both the manufacture and testing of the conduit in detail. The sections referring to the qualifications of the conduit are condensed and summarized below. Be assured that Wheatland Hot-dipped Galvanized Rigid Steel Conduit meets or exceeds the UL specifications.

The Tube

Each tube used in the manufacture of rigid metal conduit shall be steel (or other suitable metal) and shall have a circular cross-section sufficiently accurate to permit the cutting of clean, true threads. The wall thickness shall be uniform through the length of the tube. The welding of all seams shall be thoroughly well done. The welded seam shall be free from metal trimmings, sharp edges and sharp projections.

Both the inside and outside surfaces of the tube shall be thoroughly cleaned so that the protective coating will have a smooth finish. Before the protective coating is applied, the interior surface of the tube shall be examined to be sure it is free from scale.

Each tube used for rigid metal conduit shall be capable of being bent cold into a quarter circle around a mandrel, the radius of which is four times the trade size of the tube, without developing cracks or opening a weld.

The Protective Coating

Both the inside and outside of ferrous metal rigid conduit shall be protected against corrosion by a coating of zinc (or enamel or equivalent corrosion-resistant coating). The coating shall be sufficiently elastic to prevent its cracking or flaking off when a finished sample of ½-inch conduit is tested up to a year after manufacture by bending it into a semi-circle, the inner edge of which has a radius of 3½ inches.

A protective coating of zinc shall be such that a sample of finished rigid ferrous-metal conduit will not show a fixed deposit of cooper after four one-minute immersions in a standard copper sulfate solution.

The Threads

Each length of conduit is to be threaded on both ends and chamfered to remove burrs and sharp edges on the interior surface. All threads are to be clean and full cut. If threads are cut after the protective coatings are applied, they shall be treated to prevent corrosion before the conduit is installed.

The Finished Conduit

Every piece of conduit is to be inspected prior to shipment to be sure it is free from poor coating, scale, burrs or fins, embossing on interior surfaces or other defects.

Each length of conduit shall be marked "rigid metal conduit" and indicate the type of material. In addition, it shall be marked with manufacturer's name or trade mark.

FEDERAL SPECIFICATION WW-C-581

This specification covers zinc-coated rigid steel conduit in all common trade sizes. Its general requirements are that products furnished under this specification conform as applicable to ANSI C80.1 and UL 6 for rigid steel conduit.

Other provisions of WW-C-581 which should be noted when preparing bids are summarized here. For details on packaging and quality assurance, refer to the full specification.

Standard Commercial Product

The conduit shall, as a minimum, be the manufacturer's standard commercial product with any added features needed to comply with the requirements.

Identical Items

Conduit, couplings, elbows and nipples of the same classification furnished under any specific contract shall be physically and mechanically identical. No deviation will be acceptable without prior written approval of the contracting officer.

Material

All material shall be new and unused. Material not specified shall be of the same quality used for the intended purpose in commercial practice. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual component or the overall assembly.

Fire and Casualty Hazards
Each contractor shall submit proof that the conduit proposed under this specification conforms to UL6. The UL listing mark may be accepted as evidence that the conduit conforms to this requirement.

Marking
Conduit shall be permanently marked in accordance with ANSI C80.1 and UL6.

Workmanship
All threaded portions of conduit shall be clean and undamaged. Plastic thread protectors shall be furnished on all exposed conduit threads. The exterior zinc coating, and all other protective coatings, including the interior coating and thread coating, all completely and uniformly cover metal substrate.

AMERICAN NATIONAL STANDARD INSTITUTE SPECIFICATION FOR ZINC-COATED RIGID STEEL CONDUIT

The ANSI Specification C80.1 is very precise and explicit in setting standards for rigid steel conduit. Wheatland's rigid steel conduit matches these standards in every way. It meets the general requirements of having an accurate circular cross section, a uniform wall thickness, a defect-free interior surface and continuously welded seams. It is thoroughly cleaned before coating so the protective coating adheres well and is smooth. The exterior surface is thoroughly and evenly coated with metallic zinc applied directly to the steel so that metal-to-metal contact and galvanic protection against corrosion are provided. The interior surface is protected by zinc for corrosion resistance.

DETAILED REQUIREMENTS
Some of the pertinent detailed requirements of Specification C80.1 are interpreted and summarized below for your reference and assurance that Wheatland Rigid Steel Conduit is produced to precise standards.

Zinc Coating
The zinc content of the coating on the outside surface shall be equivalent to a minimum thickness of 0.0008 inches.

Threading and Chamfering
Each length of conduit shall be threaded on both ends, and each end shall be chamfered or otherwise treated to remove burrs and sharp edges. If threads are cut after the zinc coating has been applied, the threads shall be treated with a protective coating to prevent corrosion before installation. This treatment shall not impair electrical continuity through couplings or fittings after installation.

Identification
Each length of conduit shall be identified with the manufacturer's name and trade mark and the words "Rigid Steel Conduit."

Threads
The number of threads per inch and the length of the threaded portion at each end of each length conduit shall be as shown in the accompanying table and shall conform to American Standard Pipe Threads. The perfect thread shall be tapered for its entire length, and the taper shall be 3/4 in/ft.

Dimensions of Threads for Rigid Steel Conduit, Zinc Coated

Nominal or Trade Size of Conduit (inches)	Threads per Inch	Pitch Diameter at End of Thread E_o	Length of Thread (Inches)	
		Taper ¾ Inch per Foot	Effective L_2	Overall L_4
⅜	18	0.6120	0.41	0.60
½	14	0.7584	0.53	0.78
¾	14	0.9677	0.55	0.79
1	11½	1.2136	0.68	0.98
1¼	11½	1.5571	0.71	1.01
1½	11½	1.7961	0.72	1.03
2	11½	2.2690	0.76	1.06
2½	8	2.7195	1.14	1.57
3	8	3.3406	1.20	1.63
3½	8	3.8375	1.25	1.65
4	8	4.3341	1.30	1.72
5	8	5.3907	1.40	1.82
6	8	6.4461	1.50	1.92

Overhead
3φ+1φ

Description

Alcan Multiplexed Overhead Service and Secondary Cable assemblies consist of one or more insulated conductors and one bare neutral conductor. The cable assembly may be used as a service drop (power pole to service entrance) or as a secondary cable (pole to pole). XLPE insulated conductors are rated for 90° C operation.

Insulated Conductors:

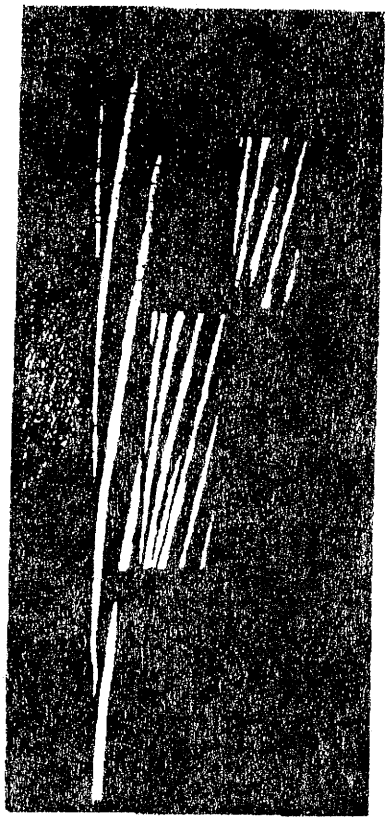
The phase conductors may be either solid or compressed stranded 1350 H-19 (hard drawn) aluminum complying with the following specifications:

ASTM—B-231
#6 Solid Aluminum Wire

ASTM—B-231
Stranded 1350 Aluminum Conductor

Insulation

Insulation is black low density cross-linked polyethylene (XLPE) in accordance with ICEA S-76-474.



The cable Assemblies bear the following surface marking at intervals not to exceed 24 inches: Alcan, (Plant of Manufacture), XLPE, (Year of Manufacture).

Neutral:

Cable assemblies are available with any of the following neutral conductors.

1. Stranded All Aluminum (AAAC) ASTM—B-231
2. Aluminum Conductor Steel Reinforced (ACSR) ASTM—B-232
3. Aluminum Alloy Conductor 6201 (AAAC) ASTM—B-399

Assembly:

One or more insulated conductors are twisted around the neutral conductor with a lay length of 15 to 60 times the diameter over the phase conductor. The direction of lay is right hand.

Electrical Testing:

After a one hour immersion in water at room temperature each length of cable, while still immersed, shall withstand 2.5 kV AC (60 Hz) phase to ground for one minute.

Markings:

The cable Assemblies bear the following surface markings at intervals not to exceed 24 inches: Alcan, (Plant of Manufacture), XLPE, (Year of Manufacture).

Unless otherwise noted, all dimensions are subject to normal manufacturing tolerances.

SUBMITTAL REVIEW

Review is only for general conformity with the design concept and is limited to requirements called for by the contract documents. Subcontractor is responsible for the accuracy of dimensions, quantities and details requiring correlation with other materials or equipment, and for information that pertains solely to the techniques of fabrication or construction.

X — No Exceptions Taken
____ Furnish as Corrected
____ Amend and Resubmit
____ Rejected

Date 7/9/03 Department ENG

By [signature]

ALCAN

ACSR Neutral

Overhead
3Ø + 1Ø

Crosslinked Polyethylene Duplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
SETTER/XLP	6 solid	45	162	252	6-6/1	1190	13	49	12	74	65	1000	3300
SHEPHERD/XLP	6-7	45	178	268	6-6/1	1190	16	50	12	77	65	1000	3300
TERRIER/XLP	4-7	45	225	315	4-6/1	1660	19	79	18	116	110	1000	2400

90° C ambient, 90° C conductor temperature, sun and wind

Crosslinked Polyethylene Triplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
VOLUTA/XLP	6-7	45	178	268	6-6/1	1190	31	74	12	117	85	1000	2200
STROMBUS/XLP	4-7	45	225	315	6-6/1	1190	39	103	12	154	110	500	1500
WHELK/XLP	4-solid	45	204	294	4-6/1	1860	31	116	18	165	110	500	1700
PERIWINKLE/XLP	4-7	45	225	315	4-6/1	1860	59	118	18	175	110	500	1500
COCKLE/XLP	2-7	45	283	373	4-6/1	1860	49	164	18	231	150	500	1800
CONCH/XLP	2-7	45	283	373	2-6/1	2850	49	188	29	266	150	500	1600
JANTHINA/XLP	1/0-7	60	357	477	2-6/1	2850	61	262	29	372	200	500	1200
PANELLA/XLP	1/0-19	60	362	482	2-6/1	2850	76	252	29	367	200	500	1200
NERITINA/XLP	1/0-7	60	357	477	1/0-6/1	4380	61	298	47	426	200	500	1200
OLIVA/XLP	1/0-19	60	362	482	1/0-6/1	4380	76	298	47	421	200	00	1200
PUNCINA/XLP	2/0-7	60	401	521	2/0-6/1	5300	92	376	59	527	230	-	1500
TRITON/XLP	2/0-19	60	406	526	2/0-6/1	5300	84	376	59	519	230	-	1300
MURSIA/XLP	3/0-19	60	456	576	3/0-6/1	6620	94	474	74	642	260	-	1300
CERAPUS/XLP	4/0-19	60	512	632	2/0-6/1	5300	106	524	59	689	300	-	1000
ZUZARA/XLP	4/0-19	60	512	632	4/0-6/1	8350	106	593	93	797	300	-	1000
COMPAN/XLP	336.4-19	80	646	806	4/0-6/1	8350	176	834	93	1105	380	-	000
CAMEET/XLP	336.4-19	80	646	806	336.4-18/1	8680	178	952	50	1180	380	-	000

40° C ambient, 90° C conductor temperature, sun and wind.

Crosslinked Polyethylene Quadruplex

CODE WORD	PHASE CONDUCTORS Size & Number of Strands	Insulation Thickness (Mils)	NOMINAL DIAMETER Bare (Mils)	O.D. (Mils)	BARE NEUTRAL Size & Number of Strands	Rated Strength (Lbs.)	NOMINAL WEIGHT (LBS./1000 FT.) Compound	Aluminum	Steel	Total	Ampacity (Amps)	STANDARD PACKAGE Coil (Ft.)	Reel (Ft.)
HACKNEY/XLP	4-7	45	225	315	4-6/1	1860	58	157	18	233	100	500	1700
PALOMINO/XLP	2-7	45	283	373	2-6/1	2850	73	250	29	352	135	-	1800
OSTENIA/XLP	1/0-19	60	362	482	1/0-6/1	4380	113	398	47	558	180	-	1200
GRULLO/XLP	2/0-19	60	406	526	2/0-6/1	5300	126	502	59	687	205	-	1500
SUFFOLK/XLP	3/0-19	60	456	576	3/0-6/1	6620	141	632	74	847	235	-	1300
STALLION/XLP	4/0-7	60	508	628	4/0-6/1	8350	178	798	93	1069	270	-	1100
APPALOOSA/XLP	4/0-19	60	512	632	4/0-6/1	8350	159	798	93	1050	270	-	1100
GELDING/XLP	336.4-19	80	646	806	4/0-6/1	8350	267	1151	93	1511	330	-	1000
BRONCO/XLP	336.4-19	80	646	806	336.4-8/1	8680	267	1270	50	1587	330	-	1000

40° C ambient, 90° C conductor temperature, sun and wind.

NOTES: 1. See Table 7 of Aluminum Association "Ampacities for Aluminum and ACSR Overhead Electrical Conductors for Additional Cases."

3. See Table 8 of Aluminum Association "Ampacities for Aluminum and ACSR Overhead Electrical Conductors for Additional Cases."

Appendix E

Statement of Understanding

I, the undersigned have received, read, and understand the Operating and Performance Monitoring Plan for the Interim Action Ground Water Treatment System at the Moab Project Site.

	Name (Please Print)	Signature	Date	Position
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				

Appendix F

Interim Action Operating Data Worksheets

Moab Ground Water Interim Action Field Data Worksheet

Date _____ **Field Rep** _____

Measurement Location	Time	Water Depth (ft)[a]	Pump Data			Field Parameters			Specific Conductance Probe Check
			Flow Rate (gpm)	Total #1 Volume (gal)	Pressure (psi)	Temp (°C)	Spec Cond (x1000) □S/cm	pH	10K Soln Value 100K Soln Value _____ Comments
Extraction Well									
471									
472									
473									
474									
475									
476									
477									
478									
479									
Totalizer		NA				NA	NA	NA	
Observation Well									
480			NA	NA	NA				
481			NA	NA	NA				
482			NA	NA	NA				
483			NA	NA	NA				
484			NA	NA	NA				
485			NA	NA	NA				
Monitor Well			NA	NA	NA				
403			NA	NA	NA				
407			NA	NA	NA				
Evaporation Pond									
Inlet		NA	NA	NA	NA				
Recirculating Pipe		NA		NA					
Staff Gage			NA	NA	NA	NA	NA	NA	

[a] measurement point is top of casing for wells and read directly from staff gage for evaporation pond

Moab YSI Specific Conductance Probe Calibration Data Worksheet

Instrument s/n

Field Representative

Date	Time	10,000 µS/cm Solution				100,000 µS/cm Solution			
		Actual Value	Exp. Date	Temp	Reading	Actual Value	Exp. Date	Temp	Reading

Appendix G

Interim Action Sampling and Analysis Worksheets

Water Sampling Field Data

Quality Assurance Sample Log

Date _____ Project Location _____ Well / Location No. _____

Sample Number _____

False Identification Location _____

Sample Type _____

Comment: _____

Date _____ Project Location _____ Well / Location No. _____

Sample Number _____

False Identification Location _____

Sample Type _____

Comment: _____

Date _____ Project Location _____ Well / Location No. _____

Sample Number _____

False Identification Location _____

Sample Type _____

Comment: _____

Date _____ Project Location _____ Well / Location No. _____

Sample Number _____

False Identification Location _____

Sample Type _____

Comment: _____

Date _____ Project Location _____ Well / Location No. _____

Sample Number _____

False Identification Location _____

Sample Type _____

Comment: _____

YSI Daily Calibrations / Checks

Date _____ **Time** _____

YSI # _____ **Initials** _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Calibration Check

	Actual	Sonde after Cal.
Temp.	_____	_____
pH 4	_____	_____
pH 7	_____	_____
pH 10	_____	_____
Cond.	_____	_____
ORP	_____	_____
Turbidity	_____	_____

Recalibration Values

pH 4 Value for calibration _____ @ _____ °

pH 7 Value for calibration _____ @ _____ °

pH 10 Value for calibration _____ @ _____ °

Conductivity Std. Value for calibration @ _____ °

Zobell Value for calibration _____ @ _____ °

Turbidity Value for calibration _____ NTU

Was DO Calib.? **Y** **N** Atmospheric Pressure _____ mm Hg Zero Check value _____

Date _____ **Time** _____

YSI # _____ **Initials** _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Calibration Check

	Actual	Sonde after Cal.
Temp.	_____	_____
pH 4	_____	_____
pH 7	_____	_____
pH 10	_____	_____
Cond.	_____	_____
ORP	_____	_____
Turbidity	_____	_____

Recalibration Values

pH 4 Value for calibration _____ @ _____ °

pH 7 Value for calibration _____ @ _____ °

pH 10 Value for calibration _____ @ _____ °

Conductivity Std. Value for calibration @ _____ °

Zobell Value for calibration _____ @ _____ °

Turbidity Value for calibration _____ NTU

Was DO Calib.? **Y** **N** Atmospheric Pressure _____ mm Hg Zero Check value _____

Date _____ **Time** _____

YSI # _____ **Initials** _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Calibration Check

	Actual	Sonde after Cal.
Temp.	_____	_____
pH 4	_____	_____
pH 7	_____	_____
pH 10	_____	_____
Cond.	_____	_____
ORP	_____	_____
Turbidity	_____	_____

Recalibration Values

pH 4 Value for calibration _____ @ _____ °

pH 7 Value for calibration _____ @ _____ °

pH 10 Value for calibration _____ @ _____ °

Conductivity Std. Value for calibration @ _____ °

Zobell Value for calibration _____ @ _____ °

Turbidity Value for calibration _____ NTU

Was DO Calib.? **Y** **N** Atmospheric Pressure _____ mm Hg Zero Check value _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____

WATER LEVELS and WELL MAINTENANCE DATA SHEET

Site: _____ **Date:** _____ **Measuring Device:** _____

	Subsurface Inspection			Surface Components Inspection*							
Well	Time	Depth to Water (ft.)	Total Depth (ft.)	Well Label	Guard-posts	Lock	Conc. Pad	Protective Casing	Riser Cap	Initials	Comments

*Surface Components Inspection: S - Satisfactory D - Deficient (comment to describe problem)

YSI Pre-Trip Calibration

Date _____ **Time** _____ **Project Location** _____

YSI No. _____

pH Buffers

4 Manufacturer _____ Lot No. _____ Expiration Date _____

7 Manufacturer _____ Lot No. _____ Expiration Date _____

10 Manufacturer _____ Lot No. _____ Expiration Date _____

Zobell Solution

Lot Number _____ Expiration Date _____

Nitric Acid

Manufacturer _____ Lot No. _____

Sulphuric Acid

Manufacturer _____ Lot No. _____

Conductivity Calibration

(for 989 standard use 0.989 to cal)

100 µmhos/cm: (_____ actual); Temp _____; conductivity reading _____ Exp. Date_____

1,000 µmhos/cm; (_____ actual); Temp _____; conductivity reading _____ Exp. Date _____

10,000 µmhos/cm; (_____ actual); Temp _____; conductivity reading _____ Exp. Date_____

pH – ORP Calibration

1 Point Calibration 2 Point Calibration 3 Point Calibration (circle) (Cal 7 buffer first)

pH 4 Buffer _____ mV Range +180 ± 50 mV PreCal actual value _____ Cal. Value _____

pH 7 Buffer _____ mV Range 0 ± 50 mV PreCal actual value _____ Cal. Value _____

pH 10 Buffer _____ mV Range – 180 ± 50 mV PreCal actual value _____ Cal. Value _____

ORP cal Initial value _____ Value after calibration _____ Temp. _____

HACH 2100P Turbidity Calibration

Instrument Number: _____

Primary Calibration Standards Expiration Date: _____

Date of Primary Calibration: _____

Hach 2100P Turbidity Meter Check

Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Dissolved Oxygen Calibration

DO Membrane changed? Y N

DO Charge _____ Range 50 ± 25

DO Gain _____ Range 1.0 -.3 to + .4

Temperature Check

(Compare temperature of any liquid with both YSI and NIST reference thermometer.)

Nist Temp_____ YSI Temp. _____ NIST Cal Date _____ NIST Cal Due Date _____

Name _____

HACH 2100P Turbidity Calibration

Instrument Number: _____
Primary Calibration Standards Expiration Date: _____
Date of Primary Calibration: _____

Hach 2100P Turbidity Meter Check
Gelex Standards

Assigned	Actual
_____	_____
_____	_____
_____	_____

Dissolved Oxygen Sensor Output Test (After DO calibration in saturated air.)

The following tests will confirm the proper operation of the DO sensor. The DO charge and gain must meet specifications before proceeding.

YSI 650 - Turn off the 650, wait 60 seconds. Power up the 650 and go to RUN mode, watch the DO % output; it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in approximately 60 to 120 seconds. (Note: Disregard the first two samples as they may be affected by the electronics warm-up.

Laptop - Stop discrete and unattended sampling. Confirm that Auto-Sleep RS-232 is enabled (Advanced Menu under Setup). Wait 60 seconds. Start discrete sampling at 4 seconds. Watch the DO % output, it must display a positive number and decrease with each 4 second sample, eventually stabilizing to the calibration value in 40 to 60 seconds.

ACCEPT / REJECT criteria is:

The DO output in % must start at a positive number and decrease during the warmup. For example: 117, 117, 114, 113, 110, 107, 104, 102, 101, 100, 100. Should the output display a negative number or start at a low number and climp up to the cal point, the probe is rejected and must not be used.

_____ ACCEPT _____ REJECT

Volume Information

Tubing Volume

ID Size	Gallons / Foot	Liters / Foot
1/4"	0.003	0.011
3/8"	0.006	0.023
1/2"	0.010	0.039
3/4"	0.023	0.087
1.0"	0.041	0.155
2.0"	0.163	0.617
4.0"	0.653	2.472

1.0 Gallon = 3.785 Liters
1.0 Liter = 0.264 Gallons

Small QED PVC Bladder pumps have a volume of: 130 ml.
Large QED PVC Bladder pumps have a volume of: 395 ml.
YSI 6920 (w/o turbidity) flow cells have a volume of: 360 ml.

Water Sampling Field Data

Date _____ Project Location _____ **Well / Location No.** _____

Well Purging Information

Sample Number _____

Water Level _____ **Casing Diameter** _____

Depth of well (database) _____ **One pump / tubing Volume** _____ (L)

Depth of well (measured) _____ 1/4" = 0.003 3/8" = 0.006 2" = 0.163 4" = 0.653 gal / ft.

Depth of water _____ 1/4" = 0.011 3/8" = 0.023 2" = 0.617 4" = 2.472 Liters / ft

Sampling Equipment *Peristaltic* *Bladder (Dedicated)* *Poly Tubing (Dedicated)*

Other:

Measurement Equipment: *YSI 6920, No.* *YS I No.* *Hach 2100P Turbidimeter*

Hach alkalinity. *Other:*

Calibration Time _____

Purge Data

Start Time _____ in situ ( ) Open container ( ) Air exclusion ( )

Time	Total Volume Purged (gal) (L)	Water Level	Temp. (° C)	Conductivity ATC (µmhos/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)
Final Sample Data						**Sample Time**		

Alkalinity (Filtered)

Time _____ Total alkalinity _____ ppm as $CaCO_3$

Phenolphthalein alkalinity (for pH 8.3 or greater) _____ (Hach Kit Method 1.6N H_2SO_4 titration cartridge)

Filters

Number of 0.45 µ disposable filters used _____

Grand Junction Office
2597 B 3/4 Road
P.O. Box 14000
Grand Junction CO 81503

Sample Number _____ Well / Location No. _____

Purge Data

Start Time _____

Time	Total Volume Purged (gal) (L)	Water Level	Temp. (° C)	Conductivity ATC (µmhos/cm)	DO (mg/L)	pH	ORP (mV)	Turbidity (NTU)

Well Inspection

Well Label	Guardposts	Concrete Pad	Protective casing	Riser Cap	Lock

Sample Preservation: Is ice in cooler (YES) (NO) **Weather:** _____

Well Category I II III IV Reason for category: _____

Comments: _____

_____

_____

_____

Signature of Sampler _____ **Date Signed** _____

Checked by _____ **Date checked** _____

Attachment 1

Construction Drawings

Contents